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Asphalt Pavements

The long paper by Mr. Andrew Rosewater on asphalt pavements, printed in this journal last week, is a decidedly interesting contribution to a subject full of disputed points and primed with difficulties due to the great business interests involved. The ways of the latter are said to be as intricately entwined with international politics as with the councilmanic welfare in places where the merits of asphalt are still unappreciated. All such talk is, of course, mainly mere malicious or careless rumor, which is always rife about great corporations and public officials. With it this journal fortunately has no concern, for the task of keeping in touch with the disputed features of asphalt technique affords all the excitement advisable in the normally placed calm of an editorial sanctum. The disputed points are so numerous and so many people are sensitive concerning criticisms of their views that it takes an engineer of Mr. Rosewater's long experience in public life to write such a paper as the one referred to. The manner in which he boldly attacks certain subjects on which most engineers speak with bated breath is highly courageous. He has been the victor in several engineering disputes of national interest, in the course of his long public career, and probably he does not mind the charges of ignorance and possibly of mercenary motive that will doubtless be made against him.

It is fortunate that an engineer of his standing and long experience has taken up the fight for a reasonable amount of personal freedom in considering asphalt pavements. The number of unsettled questions on which differences of opinion are to be expected is large, and seems to be increasing rather than decreasing. It is possible, of course, that they may be settled when greater knowledge is attained by research and accurate observation of pavements under traffic, but the present outlook is that when the last trumpet is blown there will still be a few asphalt specialists each wanting, before making up his final accounting, more time to prove how little truth the other fellows really muster on their side. If these specialists will only get together with the white dove of peace cooing on the table before them, instead of lying in wait for each other with mud pumps and ink wells, the condition of asphalt paving will be greatly improved. There are a lot of features on which they are in pretty close harmony, but they make so much noise about those in dispute that people are misled into believing there is no unanimity of opinion concerning any aspect of the industry.

In the paper by Mr. Rosewater there are some views expressed with which this journal is not wholly in sympathy and some that it is glad to see in print again. The Engineering Record is not satisfied that Trinidad asphalt deserves all the bad things said about it; there are too many excellent pavements made of it to warrant the sweeping condemnation it sometimes receives. In the same way this journal does not believe that the California oil asphalts must be forever damned because they are generally a by-product and have varied in quality in the past. It is the engineer's duty to encourage progress while practising conservatism, and so far as his clients' interests permit he should help new products by giving them good tests. The time has come when an interchange of definite data concerning technique and experience is highly desirable, provided it can be kept free from personalities and misrepresentation. It is to be regretted that Mr. Rosewater has indulged in a strongly controversial tone in some places, but a great deal may be pardoned in the leader of many good fights for sound engineering which will not be tolerated in others without such a record.

Workingmen's Houses.

The Department of Commerce and Labor has lately been publishing a number of reports concerning the homes of "working" people in Great Britain and Europe. By working people are apparently meant those paid low wages. The men who direct affairs and carry all the worry and anxiety of hard times and keen competition are rarely termed workers until after they have broken down with nervous prostration, when the same critics who previously refused them the honorable title of working men speak of them as victims of overwork. The houses for low rentals which the latest government report describes are of various types. Some are on the borderland of charitable enterprises, like the Krupp colony at Altenhof and the houses of Lever Bros., Ltd., at Port Sunlight. The Altenhof colony was established for invalid workmen, where they are housed for life without the payment of rent, and for the widows of employes. The Port Sunlight homes occupy 140 acres of land, and the buildings and other improvements represent an expenditure exceeding $1,750,000, on which sum no financial return, not even interest, is charged. The rents are fixed at an amount which pays only maintenance, taxes and repairs. These homes are not the class that most deserve attention, however, for the houses which yield a reasonable interest on the sums invested in them, in addition to fixed charges, form the only type which really deserve general attention.

It is interesting to observe the very varied views of the character of low-rental houses which are held by different observers. One critic stated not long ago that after inspection of the homes of people earning low wages in Europe, Great Britain and America, he was convinced that nowhere were squalor and destitution so manifest as in Homestead, Pa. It is often said that mill villages in New England and in Southern States are but little above the huts of the Digger Indians. Such criticisms are offset by that of Prof. Werner Sombart, of Breslau, who has lately expressed the following opinion as a result of personal studies:

"The American laborer has better dwellings than his German colleague. The average number of rooms occupied by an American workman and his family is four to five. In Germany the average is only two. The price paid in America for the larger dwelling is actually not greater than that paid for the smaller one in Germany, and wages in America amount to two or three times as much as in Germany. The interior of a workingman's home in America also looks more cheerful. The sum paid out by the average American workman and his family for new articles each year to render his home more cozy amounts to $31, while that of the 44 working families in Nuremberg amounts to only $4 or $5 on an average."

As a matter of fact it does not make much difference to the employer in Oshkosh what his competitor in Nuremberg is doing in the way of housing his employes. He will have to work out the problem for himself, and all he can learn from prolonged research will be of little direct value. The whole matter is one of either self-interest or charity. The latter need not be considered here. From the point of view of self-interest it is to the employer's advantage to have his men cheerful and healthy. He is accordingly justified in paying time and money to secure good homes for them, for cheerfulness and health depend largely on home conditions.

So far as cheerfulness is concerned, it will be influenced considerably by whether the home conditions are congenial. Accordingly it is noteworthy that in most important home-building enterprises particular attention is paid to furnishing convenient kitchens, easy stairs and plenty of light. The attempt is being made in this way to help the workman by helping his wife. Semi-detached and detached houses are constructed wherever practicable, and the old-fashioned tenement rookery of the mill village is relegated to a deserved oblivion. Special attention is paid to installing simple yet durable plumbing, and ample facilities for heating.

Out-of-doors there is a similar marked change. An attempt is generally made to have the surroundings of the cottages attractive. Very often the grounds in front of them are looked after by gardeners employed by the owner, so that the slackness of a single careless tenant in a block may not injure the appearance of the street. The tenants are often encouraged to practice their own skill as gardeners in the backyards, and prizes for the best results are frequently given. In some cases a gardener is employed to advise these amateurs, and seeds are furnished without charge. None of this aid and assistance is in any sense charity, however, and the expense is usually borne by the workmen tenants. The charge is trivial, however, only a few cents a month, and it is a noteworthy fact that the rentals in many of the most attractive places are generally lower than those in towns where the houses are owned by private landlords. The improvement of homes and the betterment of working conditions will not prevent strikes and labor troubles, but they will do much to raise the general tone of a community. This in itself is an advantage to the employer, and that it is well worth his attention is shown by the study the subject is receiving in all countries. Labor troubles we will always have, for it is human to err; but it is safe to say they will be less savage where the employer shows by his attention to housing affairs and working conditions that he differentiates between his men and his machines.

Concrete Houses.

The construction of concrete houses has progressed to such a stage that it deserves careful consideration. It is both very old and very new. Many of the famous structures of the Roman Empire were constructed of concrete and endure to this day to gratify all who appreciate art in architecture. Many inexpressibly ugly buildings of concrete blocks have lately been built, which will hurt the industry instead of helping it. This valuable building material is being condemned by people of artistic tastes because of the complete lack of appreciation of its proper use shown by many who are now promoting its sale. Nothing more incongruous can be easily imagined than a Queen Anne cottage of a material imitating quarry-faced ashlar, yet this is not rarely put forth as the crowning triumph of concrete block architecture. As a matter of fact, these blocks lend themselves to entirely satisfactory work along certain rather limited styles, but whenever they are employed to give bizarre effects by closely imitating monumental stone masonry the results will probably be poor. If those interested in the industry desire to develop it along the lines of permanent stability, they will do well to pay a good round sum to a number of architects of high reputation for artistic design, to prepare typical plans for various types of buildings. These plans if widely circulated will prevent in a measure the charges of aesthetic murder now being brought against concrete blocks.

Another matter that deserves attention is the wretched character of much of the material now being manufactured. To make clean-cut, durable blocks it is necessary to use good materials and good sense. The honeycombed pieces of dirty concrete sold for building blocks in some places are only fit for woodlot walls. Good materials must be used; it is a hopeless task to try to make blocks without them. Care must be taken in their manufacture, no matter what machine is used. It is not a difficult process, but it requires strict attention to details and a thorough knowledge of the principles which govern the preparation of concrete. The main troubles at present seem to be improper proportioning of the materials, failure to keep the moulds clean, and imperfect curing. The last is particularly prevalent, and blocks are often seen which have been dried out by the sun and wind long before they were cured. The imperfect appreciation of the importance of many details in the correct handling of concrete materials indicates that a copy of Sabin's "Cement and Concrete" would often be about as useful a part of an equipment as a block machine itself.

The use of blocks is by no means the only way to employ concrete in buildings. Some months ago there was printed in this journal a description of the attractive house of monolithic concrete built by Mr. Charles A. Matcham. Another structure as interesting is being constructed by Mr. P. M. Bruner, of St. Louis. It is a three-story and basement building of reinforced concrete, with a flat roof of the same material. Unlike Mr. Matcham's house this has hollow walls, the openings being left by the use of forms which were lifted up as the wall was raised. It should be pointed out that both these houses call for more skill than is needed in using concrete blocks, and are interesting mainly as examples of what can be done with concrete when machines are not available. Still another type of construction which deserves attention has rough walls of cheap brickwork, which are covered with concrete. This construction offers certain marked advantages in some localities, and has been employed with great success.

In every case it is essential to use the concrete understandingly, and with regard to its true artistic characteristics. If this is done the results will be gratifying; if it is not done, failure or hideous effect is probable. The use of concrete is too full of promise to be sacrificed to the ignorance that is now being displayed by some of the people who are using it in buildings, and all those interested in the industry should take steps to prevent the poor work that is now too prevalent.

The American Street Railway Association.

The great importance of the street railway interests of the country was well shown at Philadelphia last week, when the delegates to the convention of the American Street Railway Association filled the city's leading hotel and all available accommodations within a large radius of it. Both in numbers and in character, the men present showed the great change that has come over the business of local transportation since the Association last met in Philadelphia. At present one of the greatest items of operating expense is for coal, but then the only fuel charge was for an occasional bundle of straw fired under the boiler of a reluctant mule. The leading technical man then was the veterinarian, while to-day the street railway problems are receiving the attention of the most eminent men in steam and electrical engineering. In the days of that early Philadelphia convention the financial features of the business were of elementary nature, for the companies had to extend no credit to customers and the prices of rails, motive power and franchises were stable. Financial problems are complex enough now, however, and growing more complicated every day. With the advent of electric traction and the extension of lines out into the suburbs and across country with few potential passengers to other cities, the problem of the street railway becomes vastly more troublesome than before. Added to these difficulties are those of onerous franchise requirements, municipal ownership and labor agitators, and as if this were not enough in itself there is the danger of public distrust of street railway securities through the occasional collapse of companies based more on ambitious dreams than accurate estimates and sound underwriting. Taking it all in all, the street railway proposition today, although developed wonderfully from its condition fifteen years ago, is still so full of possibilities for improvement that it is most attractive to ambitious young men.

It is gratifying to observe the earnest desire of the American Street Railway Association, and its affiliated societies as well, to lend organized assistance to the development of traction methods. In the first place it has properly changed its name to the American Street and Interurban Railway Association. This change is rendered advisable by the fact that many electric railways do not run on streets and roads except for short distances, and their lines are no longer confined to the immediate vicinity of cities. It has engaged a technically educated secretary and will organize systems for collecting and distributing street railway data to its members. It is assisting in important technical investigations, and is helping forward the development of engineering improvements in various ways. It is about to collect accurate information concerning all features of street railway management and finances so that the dangers of municipal ownership may be properly presented to the public.

There is no society which has a greater opportunity for playing an important rôle. The interests it represents touch the daily life of most people. The Association can materially encourage friendly relations between the companies and the public, one of its objects according to its constitution, or it can encourage companies in a tactless opposition to all public demands, which will result in serious trouble. The administration of its affairs is a serious matter, under the program adopted last week, but fortunately for everybody that program will be initiated under the direction of Mr. W. Caryl Ely, who was persuaded to accept the presidency for a third term. The technical features of the Association's work, with which this journal is most interested, will be broadened and strengthened. They are already of much importance. Some of the best power plant papers of the year were read at last week's convention, and the discussion on track problems was of almost as much interest to municipal engineers as to the railway officials. Technically, therefore, the Association must be regarded as occupying, through its branch organization, the American Railway Mechanical and Electrical Association, an important place in the list of national societies of an engineering nature.

Accidents to Power Plants.

There are few annual reports containing more interesting engineering information than that of Mr. Michael Longridge, chief engineer of the British Engine, Boiler & Electrical Insurance Co. This company inspects and insures steam and internal combustion engines, electrical machinery and boilers, and makes tests of power plants. In the course of this work it frequently encounters unusual conditions and discovers weak features of design in unexpected places, all of which are reported impartially each year. The investigations of accidents are naturally very thorough, for each of them means a payment of insurance money by the company to the owners, and each accident furnishes data to help the company grade the character of its risks.

In the case of steam engines, 28.2 per cent. of the accidents in 1904 originated in the failure of valves and valve gear, 14.8 per cent. were defects of air pump motions, and 12.8 per cent. were troubles with spur gearing, the remainder being divided between nineteen other sources of mishap. It is of interest to observe that in the case of gas and oil engines, valves and valve gear were also the parts to give way most frequently, and it is apparent that they are in need of even greater attention than similar parts of steam engines, for 31.3 per cent. of the failures originated in them. Of the remaining accidents, 14.8 per cent. originated in the cylinders and cylinder ends, 10.9 per cent. in the main shafts, 10.2 per cent. in the connecting rods, caps and bolts, and 10.2 per cent. in the governors and governor gear. All of these accidents were not the fault of the machinery, it should be borne in mind, for 36 per cent. of the steam engine accidents and 31 per cent. of the accidents to internal combustion engines were due to causes that could not be ascertained, 16 and 22 per cent. for the two classes of engines respectively to the negligence of owners or attendants, 26 and 22 per cent. to old defects and wear, and 22 and 25 per cent. to weakness, faulty design or bad workmanship.

In the case of internal combustion engines, although accidents have originated most often in the valves and valve gear, the most serious breakdowns have been caused principally by failures of crankshafts, connecting rod bolts, flywheels and cylinder ends. The list of these mechanical fatalities is most interesting to the engine designer. Of the crank shafts broken during the year, 8 per cent. had four bearings and two flywheels and broke at the crankpin. Shafts with three bearings furnished 31 per cent. of the accidents of this nature; a fourth of them were in the bearing between the crank and the flywheel and another fourth were through the crank web next the flywheel. Cranks with two bearings and two flywheels furnished 38 per cent. of such accidents, three-fifths of them through the crankpin and two-fifths through the bearings between the crank and one of the flywheels. The remaining accidents of this nature were on shafts with two bearings and one flywheel, and were all in the bearing between the crank and the flywheel. The technical importance of such records is manifestly great. The designer of internal combustion engines, no matter how well equipped theoretically, cannot foresee all the strains due to temperature conditions, unusual explosive mixtures, and such influences peculiar to these prime movers. Accidents and breakdowns are consequently a costly but inevitable feature of the early history of any new engine. The statistics above quoted show that the internal combustion engines are almost as free from weakness and faulty design as the steam engine, and indicate that the purchaser need be no more apprehensive of trouble with them than with the steam engine.

The inspection of boilers in factories is now compulsory in the United Kingdom, and as a result of the passage of this law in 1901, the number of explosions has shown a steady decrease from an average of 82 in the ten years prior to 1902 to 53 in 1904. During the last year the company's inspectors made 53,703 internal examinations, water tests and inspections of boilers under steam, and found 353 cases of injury so serious as to require immediate attention. Of these cases, 250 were due to corrosion and grooving, 79 to fractures, 18 were overloaded or inoperative safety valves, and 6 were inoperative water gauges. Some of these cases were so serious that the use of the boilers would have certainly resulted in explosions, with accompanying loss of life and destruction of property. Such data show how important and necessary was the boiler inspection law, and indicate the desirability of something of the sort elsewhere.

Notes and Comments.

The Course of Wages in the United States from 1890 to 1904 is shown in an interesting manner in a chart in the last "Bulletin" of the Bureau of Labor. The weekly earnings of the individual employee in 3,732 establishments were 11.1 per cent. higher in 1904 than in 1890, 14.8 per cent. higher than in 1894 and 2.7 per cent. higher than in 1902. The number of working hours per week in 1904 was 4.8 per cent. less than in 1890, 2.8 per cent. less than in 1900, and 1.4 per cent. less than in 1902. On the other hand the retail prices of food, averaged according to the consumption of a typical family, were 9.1 per cent. greater in 1904 than 1890, 0.3 per cent. greater than in 1900 and 0.7 per cent. greater than in 1902. The purchasing power of the weekly earnings of the average employee was 1.8 per cent. more in 1904 than in 1890, 2.5 per cent. less than in 1900 and 1.9 per cent. greater than in 1902. These figures represent the average fluctuations in 42 diversified industries with the employees engaged in 350 classes of occupations.

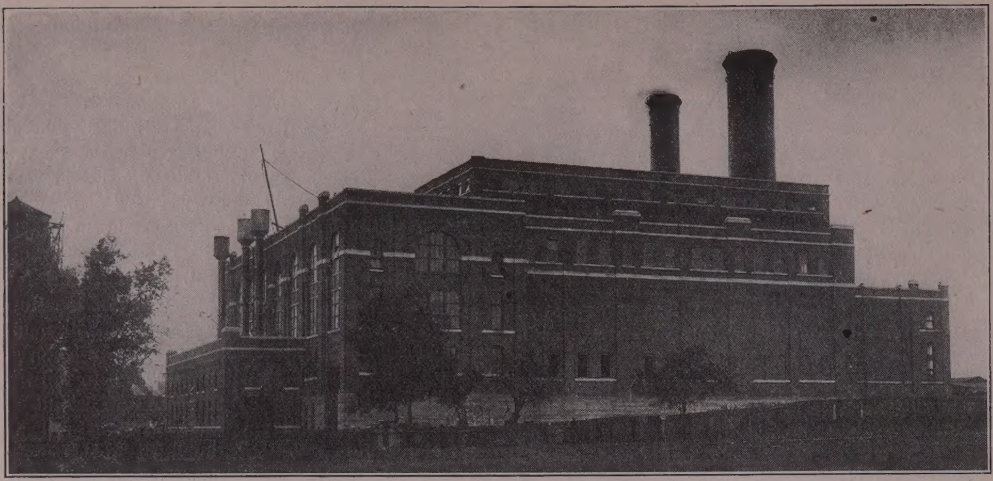
Concrete Cross-Ties continue to give such different results on the railroads where they have been tested that comparatively little definite general information concerning them is available. On one important line which experimented with several types, all of them are pronounced complete failures, while on other lines they are considered promising substitutes for wood. An investigation of their service records shows two rather general conditions; the first is the tendency of the concrete to break away from the reinforcement when much steel is used, and the second is the trouble in keeping the fastenings in the ties. Both these conditions might have been anticipated by those well acquainted with concrete, and are preventable. The general construction of a reinforced tie can be made strong enough to resist general disintegration under traffic if the ballast is properly tamped. The rail fastenings will give little trouble if they are driven in wood plugs. Just how large a field is open to such ties is still completely unknown, however, for until their cost and life are determined their financial relations to wood and steel ties cannot be ascertained.

The New Talla Water-Works, recently completed, relieve the people of Edinburgh of any danger of deficient water supply for many years to come. The works were begun ten years ago, when the city seemed on the verge of very serious troubles from this cause, and will furnish 24,000,000 gal. daily when the present pipe line is duplicated. The old supply is about 21,600,000 gal. daily and the population served is about 455,000. The reservoir is about 35 miles from the city, measured along the aqueduct, and is formed by an earth dam which rises about 90 ft. above the river bed. The puddle core is 1,300 ft. long, 124 ft. high, 40 ft. wide at the base and 10 ft. wide at the top. The dam is 20 ft. wide on top and about 600 ft. at the river bed, and is mainly of a gravelly material. Two features of the works are particularly interesting to American engineers. The first is the provision to return to the river about 6,000,000 gal. a day as compensation water, and the second is the filtration of the supply, althoough in the whole gathering area of 6,180 acres of hill pasture there is only 440 acres of peat land. The city owns over nine-tenths of the catchment basin.

Track Stiffness under trains is an important element in rendering possible high speeds and low operating costs, and the improvement in stiffness that has followed the introduction of rails of rational cross-section has been very great. Dr. P. H. Dudley has stated in a lecture before the Harvard Engineering Society that when he began work with his well-known track indicator, the undulations in the track averaged 6 to 8 ft. to the mile, while they are now only 2 ft. to the mile on the best roads. The most interesting case of improvement is probably that of the Boston & Albany R. R. When it began laying its 95-lb. rail in 1891 the undulations were 8 ft. per mile, while in 1897, when the heavy rails were all down, the undulations were only 1.75 ft. per mile under the same wheel loads. This improvement of track, largely due to Dr. Dudley's work, is now being duplicated on street railways by Mr. Albert B. Herrick, and is teaching the same lessons. The subject is full of more difficulties than are apparent on casual inspection, and the study of the depression under a single wheel, the usual object of theoretical anaysis, is of little value in showing the effect on the resistance of a train of all the undulations under it. In a general way it has been found that the distribution of the same load over more axles reduces the undulations, but that is about the limit of experimental results up to the present.

Railroad Economics, if the expression may be permitted, have been raised to the rank of liberal educational subjects by the recent action of the University of Chicago in establishing a four-year railroad course. An advisory board, composed mostly of railroad men, has been established, with F. W. McKenna, assistant to President Earling, of the Milwaukee & St. Paul, as chairman, and Daniel Willard, second vice-president of the Burlington, as vice-chairman. These men will shape the courses and will themselves deliver lectures. The first year's course will be devoted to railway conditions in the United States, the second to freight service, railway transportation, railway law and rate regulation; the third to passenger service, statistics and geography of railways, signaling and train service, railway auditing and finance and terminals; the fourth to motive power, car equipment, track, railway development abroad and the economics of railway locomotion. The announcement of this course will doubtless shock some of the old fogies who still believe that university education should have a broadening effect on the character of those receiving it. These people will do well to recall the old saying, "tempora mutantur et nos mutamur in illis." When the University of Chicago has this new course on a paying basis, it ought to carry on the good work by establishing a carefully considered scheme of education in culinary economics. American ignorance of this subject is dinned into our ears continuously and it offers a great and unexplored field to people who hold that anything is higher education provided those teaching it are called professors.

Comments on the Panama Canal like those by Mr. Waldo elsewhere in this issue are interesting as showing the opinions held by a considerable portion of the engineering employees of the Commision. There is another side, however, of the the general administrative methods which he criticises so vigorously. The inertia of red tape which he seems to consider due to War Department control is not peculiar to that executive branch of the government, but is found in all branches. Army officers dislike it as much as the civilian engineers who suffer from its peculiarities, but the officers have become accustomed to it. Moreover, they know that while it is slow, it is better calculated to keep down official wrong-doing and to promote thoroughness than any system yet devised for public offices which must be operated with employees selected by civil service. It is useless to endeavor to run a great government undertaking like a private business. In a recent magazine article, Mr. John F. Wallace states that the present canal force could have been better provided for had the simple established business methods been used that are everywhere employed in private enterprises for securing and furnishing men and material. Under ordinary conditions, the providing of proper facilities for the feeding of employees would have been a very simple matter, he says, if unhampered by governmental regulations and handled by the common-sense methods used by contractors conducting large construction operations. These observations may be literally true, yet nobody acquainted with the pitfalls and political environment of public construction would care to see the administration of the Panama Canal Commission conducted by the same detailed methods that are employed by large contracting firms. Government administration must inevitably and rightly require red tape unnecessary in private administration. It is one of the disagreeable features to be expected by those entering government service, and the only spirit in which it can be properly met is one of co-operation with the administrative officials whose duty it is to see that the safeguards required by law and regulations are observed by everybody.

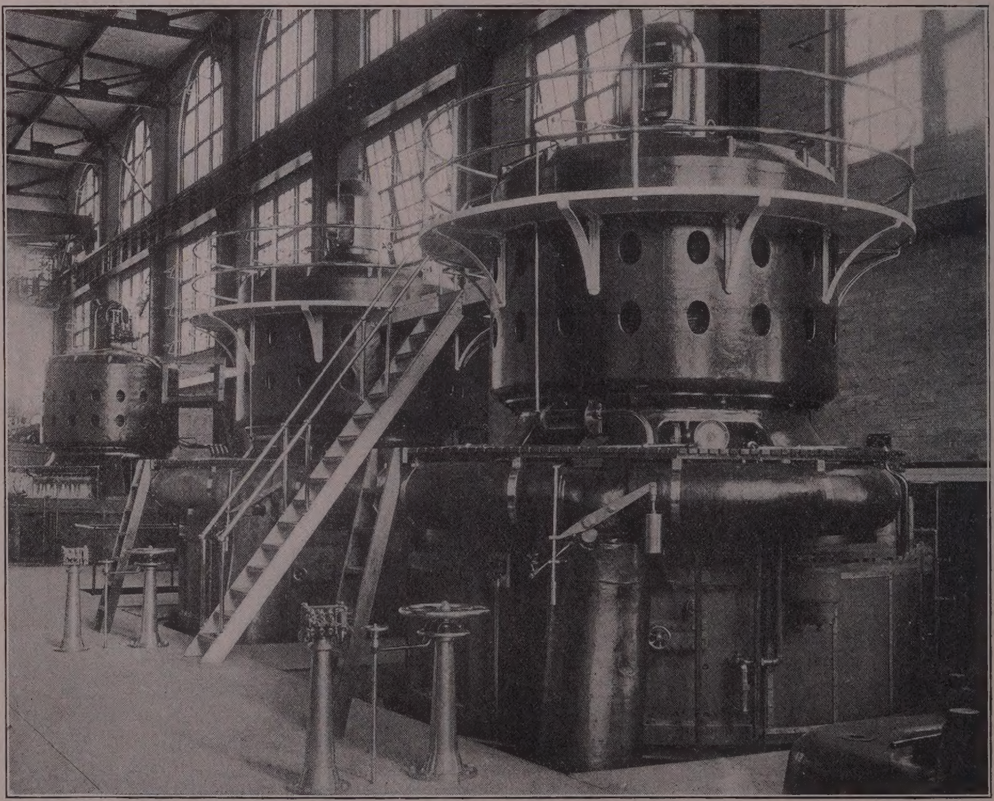


NEW STEAM TURBINE POWER PLANT OF THE DETROIT EDISON COMPANY.

A large new central generating plant has recently been completed by the Detroit Edison Co., at Delray, one of the river-front suburbs of Detroit. The total rated capacity of the initial installation is 12,000 kw., but the plant has been designed to permit of more than doubling its present capacity without change to many of the important features of auxiliary equipment, such as coal handling apparatus, the condenser intake and discharge connections, etc. The new station is, in fact, the nucleus of a broad and comprehensive new power scheme of the company, involving a far more extensive and complete city distribution system by the local sub-station method, and also the supply of current for power and lighting over large areas of suburban territory, much of which is at present without the advantages of electricity.

The new plant is, however, the immediate result of a remarkable development during the past few years of the local distribution business of the company, which had seriously overloaded the independent steam plants formerly operated. About three years ago it developed that it would be impossible to provide for the rapid growth of the system by further extensions to the four independent generating stations then in existence, and it had been practically decided to install a large central generating plant on the river front near the center of the city, when a plan was proposed to construct a large and efficient generating plant in the "salt lands" district upon the Detroit River below the city, and from there deliver electrical energy to the various distribution systems operated by the constituent companies, utilizing the exhaust steam for the production of salt by the forced-evaporation process. Westinghouse, Church, Kerr & Co. were retained as engineers for the new project and made special investigations of this and the several other plans that were offered, with the result that the above scheme was adopted. For this purpose the Detroit Edison Co. was organized, which should install the new plant and supply current in wholesale quantities to the constituent companies operated and to other possible large consumers; the distribution business is still retained by the former Edison Illuminating Co., which supplies 120 and 240-volt direct current on the Edison three-wire system, and the Peninsular Electric Light Co., which supplies single-phase and three-phase, 60-cycle, alternating current through high-tension overhead mains. Another large consumer was secured in the Detroit United Railway Co., which will receive power for its lines in the Delray and down-river districts from the main generating station.

For the site of the new station a 38-acre tract was secured at Delray between Fort Wayne and the works of the Solvay Process Co., a section noted for its salt deposits. This location was also favorable as to the cost of the property, dockage facilities upon the river for receiving coal or shipping purposes by water, and also for railway terminal facilities. Fortunately a stratum of heavy blue clay was found to underlie the site so that suitable foundations were secured by spreading the footing courses to keep the loading upon the clay bottom under three tons per square foot, and thus the necessity of piling was avoided. The station was located at the river end of the plot for accessibility to the condensing water supply, and has been so laid out as to permit of large additions to its capacity; the ultimate design, as at present laid out, permits of increasing the station capacity to 30,000 kw. or over without alterations to the initial condenser-circulation water facilities, although the present installation of 12,000 kw. capacity will, it is thought, provide for the growth of the system for the coming year or more.

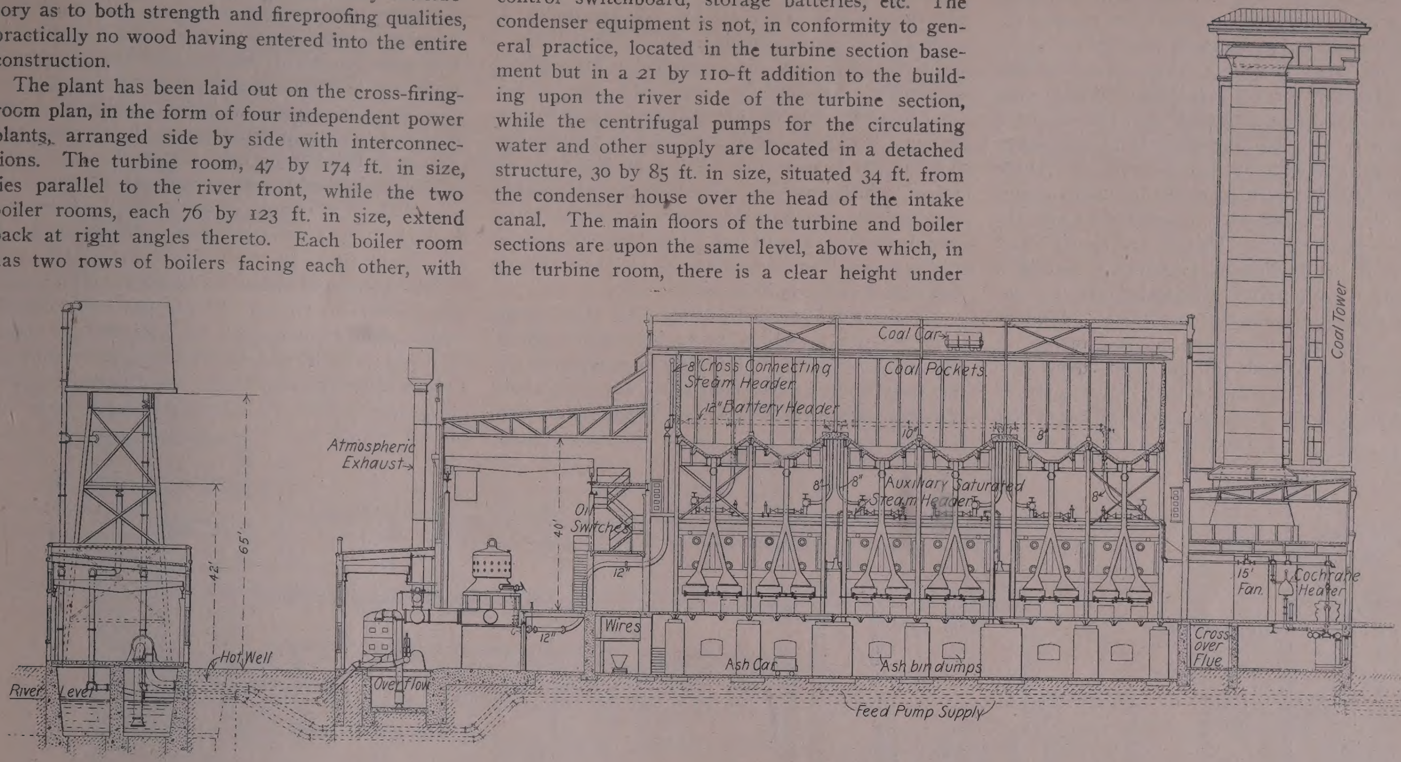


General View of Turbine Room.

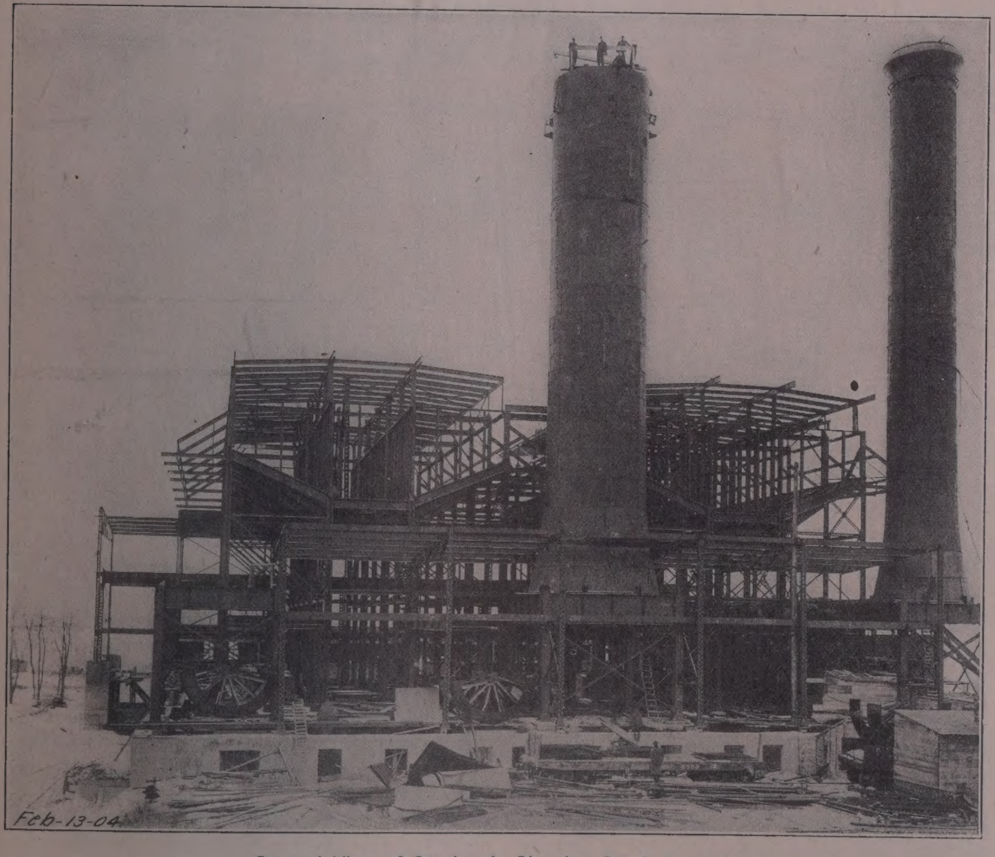
The power house is a large, substantial structure of steel frame construction with brick walls and reinforced concrete floors and roofs for the purpose of securing a thoroughly fireproof construction throughout. Concrete has, in fact, played an important part in the construction of the building, all the footings and foundations and even the outside walls up to the main floor level having been formed of this material; the floors, roofs and coal bunkers were also built of reinforced concrete construction. As above noted the footings for all foundations were carried down to broad bearings upon the clay bottom below the extreme low-water level in the river, where, by sufficiently distributing the bearing weights so as to keep it less than three tons per square foot, all underpiling was avoided; precautions were also, of course, taken to see that no conduits or trenches for pipes paralleled any of the foundation walls below the grade of their footings, so as to cause possible settlement. Above the main floor level the structure is of brick and steel construction, curtain walls of brick being used between the steel columns. The exterior has been finished as plainly as possible without an entire sacrifice of architectural effect, a limited amount of trimmings in sandstone having been used to break the monotony

For the floors, roofs and other concrete partition details the Kahn system of reinforcement was used, all work of this nature having been installed by the Trussed Concrete Steel Co., Detroit, Mich. All floor and roof beams are of steel I-beams, between which are distributed the Kahn reinforcing bars at spacings required for the loadings to be carried. This construction was also applied in an interesting manner to the coal bunker sides and bottoms, and to the boiler and furnace foundations and details.

The coal bunker floors are carried by 20-in. I-beams spaced 40 in. apart, between which the Kahn trussed bars are used for the necessary stiffening; the vertical partition walls are reinforced by 12-in. I-beams spaced 4 ft. 10½ in. apart. By a special arrangement of beams the bunker floors are caused to incline from all directions toward the outlet chutes, to prevent pocketing of the coal. The boiler house roof is carried on 10 and 12-in. channels spaced 6½ ft. apart, between which are laid the Kahn trussed bars; the floors of the firing aisles are supported upon 15-in. I-beams spaced 6½ ft. apart, with the trussed bars between. The result of this construction has been very satisfactory as to both strength and fireproofing qualities, practically no wood having entered into the entire construction.



Longitudinal Section through Entire Plant.



General View of Steelwork, Showing Stack Support.

The plant has been laid out on the cross-firing-room plan, in the form of four independent power plants, arranged side by side with interconnections. The turbine room, 47 by 174 ft. in size, lies parallel to the river front, while the two boiler rooms, each 76 by 123 ft. in size, extend back at right angles thereto. Each boiler room has two rows of boilers facing each other, with a 13-ft. firing aisle between and a clear space of 12 ft. at the rear of either row for the flue connections, economizers, etc. At the north end of the boiler section there is a two-story 37 ft. x 155 ft. section, which is devoted to the boiler auxiliaries, including the mechanical draft apparatus, the feed-water heaters, pumps, etc., and alongside in a tower is the coal-hoisting, cracking and screening apparatus. The turbine room contains on the outer side four turbines and on the side adjacent to the boiler section two galleries for the electrical switching apparatus, the control switchboard, storage batteries, etc. The condenser equipment is not, in conformity to general practice, located in the turbine section basement but in a 21 by 110-ft addition to the building upon the river side of the turbine section, while the centrifugal pumps for the circulating water and other supply are located in a detached structure, 30 by 85 ft. in size, situated 34 ft. from the condenser house over the head of the intake canal. The main floors of the turbine and boiler sections are upon the same level, above which, in the turbine room, there is a clear height under roof trusses of 39½ ft., and in the boiler room of 34 ft. clear under the coal bunkers, or 67 ft. up to the roof above. There is a basement with a clear height of 12 ft. 6 in. under both sections, the floor of which is practically on the ground level of the surrounding yard. The condenser section and pump buildings are 26 and 22 ft. high inside respectively, and like the turbine room they are served with traveling cranes for facilitating the handling of parts. The cranes were supplied by the Northern Engineering Works, that in the turbine room being of 35 tons capacity and operated by three-phase induction motors, while those in the condenser and pump houses are 15-ton hand-operated cranes.

Boiler Plant.—As above noted the generating equipment provided in the new station embraces a total capacity of 12,000 kw., which is distributed in four 3,000-kw. turbine units. Each of these will be supplied with steam by six 520-h.p. water-tube boilers, of a new combined superheater type of the Stirling Co., making 24 boilers in all. This capacity in boilers was selected on the basis of a consumption of 17 lb. of superheated steam per kw.-hour when operating condensing or 40 lb. per kw.-hour when non-condensing—five of the boilers will supply one of the turbines operating at normal full load and non-condensing if worked at 40 per cent. above rating. Each boiler has 4,834 sq. ft. of water heating surface and 2,000 sq. ft. of heating surface in the superheater, and is so designed that it may be, if desired, operated as a simple saturated steam boiler with 6,834 sq. ft. of water heating surface. The superheater tubes are, in this new type of boiler, arranged in the form of a vertical nest with sectioned steam drum at top and bottom ends, similar in general arrangement to the main water tubes; by means of the baffles in the drums the steam is caused to pass from upper to lower drum and back twice, for more thorough contact with the heating surface. The superheater nest is located between the others with the steam connections made at the upper drum, which connections are provided with a by-pass for regulating the amount of flow through the superheater and a system of spray piping for introducing water into the lower drum, all for controlling the degree of superheat in the steam delivered.

The boilers are all equipped with Roney stokers, manufactured by the Westinghouse Machine Co., the use of stokers having been found to offer many advantages in efficiency, adaptability to all classes of fuel, greater ease of regulation and also economy of building space. The two stokers under each boiler give a combined effective grate area of 126 sq. ft., which is ample to drive the boiler at the above noted overload when supplied with a ⅜-in. draft and good coal. The two engines operating the 12 stokers under each row of six boilers are elevated so as not to obstruct the firing aisle or side passageways, and have their drives so arranged that either engine may drive either half or all of the stokers as necessity requires.

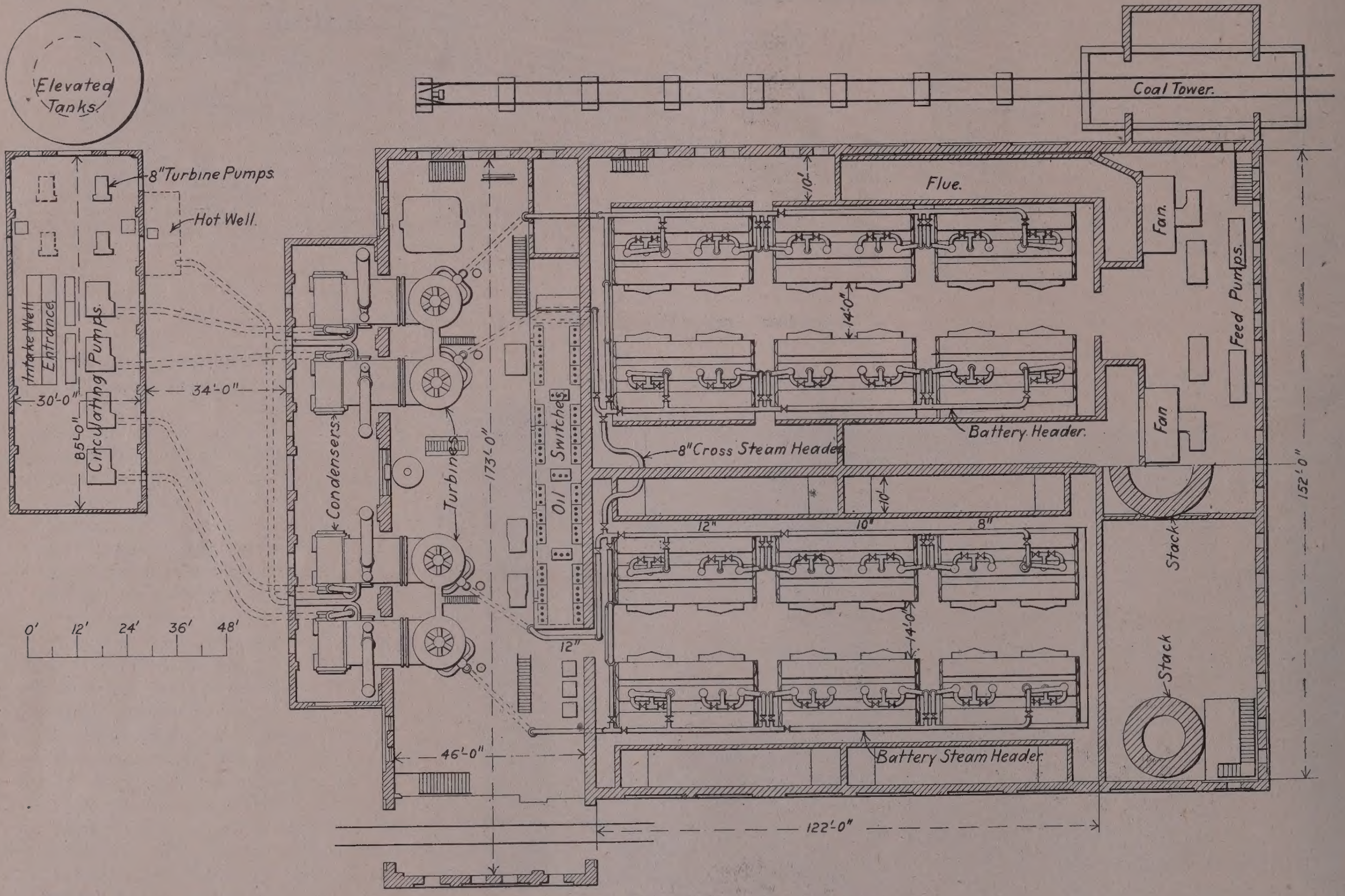
Coal and Ash Handling.—The coal handling system provides for delivery from railroad cars through an extensive system of coal bunkers of a total capacity of 5,000 tons, directly to the stoker hoppers, entirely without manual handling. There are three bunkers over each of the boiler rooms, the middle one being used for nut coal and the outside ones for slack. This is perhaps the first instance of the sorting of bituminous fuel in a power plant, the purpose being to burn the screenings or slack grade during conditions of light or medium loadings, keeping the nut coal in reserve for times of heavy loads and the "peak" overloads, by which means it is found that the capacity of the station may be increased from 50 to 75 per cent. Each of the down spouts from the bunkers to the stokers have a bifurcated connection to the bins with a valve in either branch, operated from the floor so that either grade of fuel may be drawn out at any time and in any proportion desired.

The coal-handling plant by which the coal is delivered from the cars to the bunkers entirely without manual handling is one of more than usual interest in that it involves a radical departure from the more usual methods. It involves a tower of structural steel construction, copper-covered, 32 ft. square in section and 155 ft. high, in which is housed at various levels a track receiving hopper, crushing rolls and screens, weighing hoppers, hoisting apparatus, etc., and an industrial railway for delivery to the bunkers. The incoming track by which cars of coal are brought to the plant enters upon a trestle, passing through the base of the tower at an elevation of 18 ft. above ground level, below which there is a track receiving hopper of a capacity sufficient to hold a carload of coal or more. At one side of the tower there is a 2-ton Hunt tub coal hoist which is filled at the base of the receiving hopper and elevates at the rate of 70 tons per hour to a 20-ton bin at the top, 120 ft. above ground level. This bin has a grill bottom at one side and under the outlet a heavy-duty coal cracker, thus allowing the fine coal to screen through directly while all the larger lumps are automatically delivered to the crusher. The hopper beneath this delivers to the revolving screen which sorts the slack into one bin below and the nut coal into the other. From the latter two bins the cars of the Hunt industrial cable railway are filled for dumping into the desired bunkers over the boiler rooms.

The coal tower has five floors, the first on the level of the incoming track, the second 27 ft. above, carrying the cable railway machinery for the operation of the industrial track system above the coal bunkers for the distribution of coal, while the third is on the level of the top of the coal bunkers and is connected therewith to accommodate the cable railway tracks. The fourth floor is 12 ft. above this and carries the screen equipment and the driving motors, while the fifth floor, 116 ft. above the ground level, carries the receiving bins, and the hoisting machinery for operating the tub hoist; this conveyor is of the mine skip type, the tub being lifted directly by the hoisting engine at the top. The car or tub has two sets of guiding wheels running in different channel bar guides which are so arranged at the top as to cause the tub to dump automatically into the receiving bin when at the highest point of its travel. The cable railway tracks bring the industrial cars beneath either of the sorting bins from which they may be quickly filled through double gate valves at the outlets for quick opening and closing, and started toward the coal bunkers. The cable system for the operation of these cars is of the Hunt type, and makes a circuit of the boiler house with six loops so as to cover longitudinally each of the three coal bunkers on either side. These cars are arranged for automatic dumping by means of adjustable trips which may be located at any point desired upon the circuits. All of the coal-handling apparatus is driven by steam engines with the exception of the revolving screen, which is motor-driven, the first cost of steam-driven apparatus having been found to be cheaper than the electrically driven while the cost of operation and repairs was found to be about the same in either case. The entire equipment was furnished and installed by the C. W. Hunt Co.

The entire coal handling system has a capacity of from 50 to 75 tons of coal per hour, so that with the maximum coal consumption of the entire plant of 300 tons of coal per twenty-four hours, it will not be necessary to operate the entire equipment more than six hours per day, unless the plant be operated non-condensing for use in connection with the production of salt, in which case the coal consumption would be nearly doubled. The coal tower was designed and built to permit of easily doubling its present capacity to provide for the proposed extension of the plant to double its present size. In this connection it is to be noted that a large reserve coal-storage capacity has been provided by the arrangement of the incoming coal delivery track upon a trestle from 15 to 18 ft. above the ground level and over 200 ft. long. The space beneath the trestle has been arranged for open coal storage, in which it is estimated that 80,000 tons may be stored, and cars may thus be dumped thereupon directly from the trestle. A paralleling track upon the ground level permits of coal being reloaded into cars by means of a locomotive crane with grab bucket which has been provided for this purpose and for the shifting of cars on the tracks within the ground.

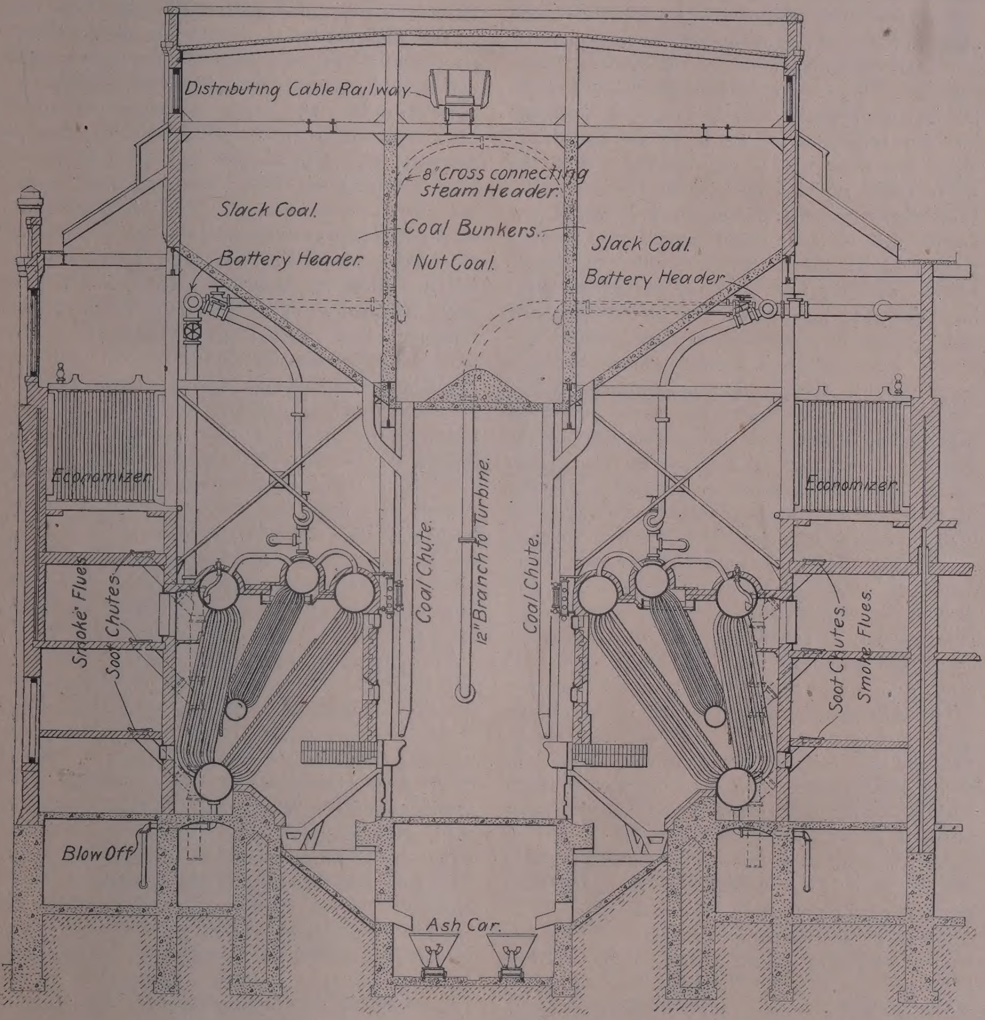
The ash-handling system is comparatively simple, consisting of bricklined concrete hoppers, un-



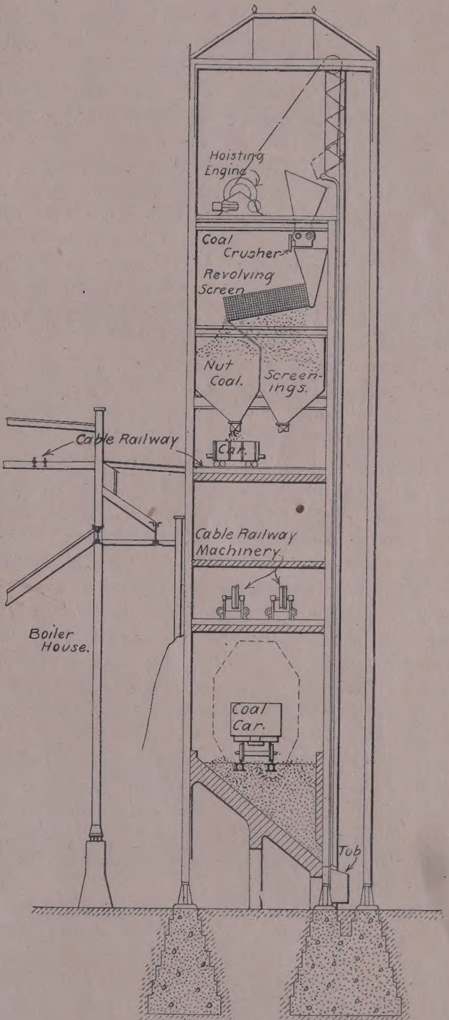
Plan of the New Detroit Edison Power Plant.

derneath each pair of stokers which deliver by gravity to industrial railway cars operated on the track system in the boiler-house basement; these cars are at present run over temporary track to portions of the site which it is desired to fill to grade, the space available for such filling being sufficient to obviate the necessity of hauling the ashes away for several years to come. The ash bins beneath the furnaces slope foward toward the outlet chutes beneath the firing-aisle floor which chutes are provided with gates permitting the ashes to be discharged directly into the ash cars. Also down-chute connections are provided from each of the flues and the economizer passages for delivery of soot accumulations directly to the ash cars without handling.

Draft.—Draft for the furnaces is supplied by a combination of stack and induced draft apparatus. There are three stacks, one of which, serving the two rows of boilers in the middle of the house, has an inside diameter of 16-ft., while those serving the outside rows are 11-ft. inside. All rise to a height of 132 ft. above the floor line of the boiler room and provide a draft sufficient, when the economizers are cut out, to operate their boilers at three-quarters rated capacity. The stacks are all of the self-supporting type of steel plate construction, and are carried upon structural steel supports directly over the induced draft fan equipment, and 22 ft. above the floor line. The shell is in each case lined with common red brick throughout its entire length, varying in thickness from 16 in. at the base to 4¼ in. at the top. In the design of the flue connections to economizers and the stacks, practically 40 sq. ft. of flue area was allowed per thousand horse-power of boilers in the station.



Cross Section of One of the Boiler Rooms.



Coal Handling Tower.

The mechanical draft equipment, designed and installed by Westinghouse, Church, Kerr & Co., consists of four specially designed fans, each located underneath its stack and exhausting the gases from a single set of six boilers. The fans, which were supplied by the Niagara Radiator Co., have wheels 15 ft. in diameter by 6 ft. 6 in. wide at the periphery, and are driven by Chandler & Taylor automatic engines, the steam consumption of which for operating each fan at its normal capacity is considerably less than 1 per cent. of the boiler horse-power which it serves. Each fan is so located as to be directly in line with its flue from the boilers, although the four boiler flues are provided with a cross connection so that any three of the fans can serve all four rows of boilers in case one fan is out of service. When the economizers are in service the four fans will produce sufficient draft to operate twenty out of the twenty-four boilers at 50 per cent. above rating, this assuming that a coal capable of evaporating 7½ lb. of water is used.

Economizer.—The Westinghouse circulating economizer equipment, manufactured by the Green Fuel Economizer Co., was selected and there have been installed eight separate economizers, each made up of 52 sections of tubes with 12 tubes to a section. The arrangement of economizers and flues is such that each economizer serves three boilers, while it may, if necessary, be by-passed when cleaning or repairs are necessary. An electrically-driven scraper equipment is used with each economizer for keeping the economizer tubes free from soot at all times. Under conditions of operation to date it is found that feed water entering the economizers from the heaters at a temperature of 120° F. is delivered to the boilers at temperatures of from 240° to 290° F., each economizer thus doing the work of a 250 to 300-h.p. boiler, when the waste gases of combustion leave the boilers at from 400° to 500° F. The economizers thus increase the capacity of the station by about 20 per cent., and by reducing the temperature of the waste gases to about 200°, their volume is reduced to about 40 per cent., which reduces the work that the mechanical draft equipment and stacks are required to perform.

Boiler Feed.—The boiler feed water supply is taken from the condenser hotwell outside of the pump house basement into which the condensation from the turbine condensers is delivered, make-up water being taken from the river intake. It is delivered by two 8-in. Worthington low-pressure turbine pumps, each of which is driven by a 60-h.p. General Electric motor and is capable of supplying all the water required for the operation of the station, to a duplicate delivery system, to which are connected two elevated tanks alongside the pump house, one of 65,000 and the other 10,000 gal. capacity. The control of these pumps is so arranged as to keep these tanks full at all times and thus maintain a sufficient boiler supply in case of sudden failure of one of the centrifugal pumps. The delivery system consists of two cast-iron mains, of a capacity sufficient to serve the present and future stations, which are brought up in and extend the length of the fan room basement, with connections to each of the specially designed 5,000-h.p. Cochrane feed water heaters. Connections are also made to the four feed pumps directly, although, unless the feed water heaters are shut down for cleaning, the feed will always be taken through them to the pumps.

Each of the boiler feed pumps is a compound Corliss-valve outside-end-packed Worthington duplex pump, having cylinders 12 and 18 by 8½ in. in diameter by 18 in. stroke. These four pumps are connected up with their boilers and economizers each with a duplicate system of high-pressure piping and the four independent systems of duplicate piping are cross-connected so that any one of the feed water heaters may be cut out and the other three utilized to operate the plant, so that cold water need not be fed direct to the economizers in any case. For further precautions against possible shut-down, each boiler is equipped with a Penberthy injector of 500-h.p. capacity, which is supplied with water under pressure by means of a special system of piping from the elevated tanks. There are thus three independent methods of feeding preheated water to each boiler, so that the possibility of shut-down is very remote.

Piping.—The high-pressure steam piping of the plant has been arranged in two systems, one for the superheated steam and the other to supply saturated steam to the auxiliary equipment engines, pumps, injectors, etc. For the former radical departures from usual piping practice were necessary to provide for the more severe conditions imposed by the very high temperatures of superheat to be reached—the necessity for this will be evident when it is considered that the elongation of a 100-ft. length of pipe from 70° F. to 587° F. (the temperature of steam at 200 lb. pressure with 200° superheat) is over four inches, which is more than double that encountered with saturated steam of the same pressure. All sections of the steam mains were made as short as possible and expansion has been allowed for by numerous long-radius bends, all connections from sections of the headers to each other, to the boilers and to the turbines having been made through bends of sufficient length to allow for several inches of play. All fittings, bolts, etc., were designed heavier than the regular standards for high-pressure service and in some cases steel fittings were used instead of cast-iron to reduce the possibilities of accident from breaking under strain. The pipe used is selected full-weight wrought-iron pipe, with welded wrought-iron flanges of extra heavy design; for all flange joints, thin corrugated copper gaskets were used, inserted within the row of bolts where the contact face of the flange is raised 1-32 in. All valves used in the superheat mains are of special all-steel construction to the entire exclusion of composition metals which may soften, due to the very high temperatures. Coldwell & Wilcox automatic non-return stop valves are used at the boiler steam main connections.

Among the other piping systems installed are the exhaust systems, the auxiliary drip system, the oiling system, the air system for the cleaning of electrical apparatus and boilers, the fire system, etc. The exhaust systems are extremely simple, consisting in each case of an independent large rectangular pipe, 30 x 126 in. in section, leading directly from each turbine to its condenser, with an automatic atmospheric exhaust connection; this is made through two combination relief and back pressure valves on the rectangular pipe with a common discharge connection of 30-in. pipe rising through the condenser house roof to an independent exhaust head for each turbine. Provision is made here for connections to the salt block later on.

The question of high pressure drip piping proved a simple one as the battery headers and cross connecting mains were high enough to drain back directly to the boilers by gravity, so that no drip connections were provided except at the base of the branch connections leading down to the turbine throttles; here are connected Bundy steam traps which return any accumulated condensation to the open feed water heaters. Particular attention was paid to the covering of all steam piping with non-conducting sheathing. This was unusually important in the case of the superheated steam lines in which, if not protected with a good covering, there will be a loss of superheat of ½° F. per foot of pipe passed through. These lines were covered with an insulation nearly four inches thick, which was composed first of a one-inch coating of long-fibre asbestos cement reinforced with a layer of two-inch mesh galvanized wire netting, over which was placed two layers of one-inch thick uncanvassed 85 per cent magnesia sectional covering, applied so as to break joints in both directions; these were firmly stapled together and all interstices filled with magnesia cement before the final layer of long-fibre asbestos cement was applied to a thickness of ¾-in. and covered with 7-oz. duck. The flanges, valves and fittings are also covered to the same thickness with plastic asbestos and magnesia cement, secured in position with the wire netting, and covered with canvas.

Turbines.—The 3,000-k.w turbo-generator units above referred to are of the four-stage type vertical Curtis turbines built by the General Electric Co. They are mounted upon hollow circular concrete foundations with large side openings into the basement for access to the step bearings. The water type of step bearing is used, the water being supplied by two 12 and 3½x15-in. Worthington pressure pumps which deliver in connection with an accumulator for ensuring an even pressure at all times. The only oil used in connection with the turbines is in the steady bearings near the generator; this oil is circulated and purified in a specially designed oiling system by small duplicate steam pumps. The turbines exhaust directly into independent surface condensers, each of which has 12,000 sq. ft. of tube cooling surface, which were supplied by the Wheeler Condenser & Engineering Co.; these condensers were designed to produce a vacuum of 28-in. at the turbine exhaust when supplied with circulating water at 70° F. Each condenser is operated by an Edwards triplex air pump driven by a 50-h.-p. General Electric motor and delivers the condensation to a hot well. Circulating water is supplied by an 18-in. Wheeler centrifugal pump in the pump house, which is direct driven by a 75-h.-p. General Electric motor.

The turbo-generators are wound to deliver 60-cycle, three-phase current at 4,600 volts potential, and are designed for a heavy overload capacity, which permits them to be operated continuously at 50 per cent. above rating, and for short intervals at 70 per cent. above. The excitation current is supplied by two 50-kw. motor-generator sets, operated in conjunction with an 83-cell storage battery for protection from momentary interruptions of the excitation supply with the attending disastrous results. Each of the exciters is driven by a 75-h.-p., three phase induction motor and has a voltage range of 125 to 200-volts. The battery "floats" constantly upon the excitation system and at a voltage of 125 volts has a capacity for 400-amperes for two hours consecutively. The battery is protected against destructive discharge into either exciter in case the latter is disabled or stopped, by a reverse-current relay which will immediately open the exciter's circuit and leave the system upon the battery.

The energy generated in the four turbine units is led direct to the bus-bars of a 24-panel high-tension switchboard in the electrical galleries, through the usual quota of oil switches, instrument transformers, etc. The bus-bar arrangement of the board involves, in line with the sectionalized arrangement of the station into four separate and distinct power plants, four separate sections, which may be interconnected or run separately as desired. Each section of the board comprises an oil switch controlling one of the 3,000-kw. turbo-generators and five oil switches for out-going feeders, the type H oil switches of the General Electric Co., having been used. Nine feeder panels are at present in use delivering current to the various sub-stations about the city, the feeders running through trunk line conduits throughout; for the latter there is an 18 section line of conduit leading out from the station and in addition there are trunk lines between the various sub-stations for interconnecting tie-lines to ensure reliability of service. In the generating station equipment is to be noted a 1,000 kw. motor-generator set which is used to supply direct-current at 600 volts to the lines in the western portions of the city of the Detroit United Railway.

Circulating Water System.—The intake and overflow connections with the river for the circulating water system have been arranged in an interesting manner in this plant. All water used in the station comes through trash racks and screens into the well beneath the pump house in which it stands about 8-ft. deep. The floor line of the pump house is about 8 ft. above normal river water level and thus all pumps, for both boiler feed systems and condenser circulation, have short lifts and direct independent suctions. The circulating water is delivered to each condenser by an independent 18-in. centrifugal pump, while the overflow from the condensers is discharged into a common canal built underneath the condensers and extending out to the river below the intake canal. The condenser overflow pipes are carried down below the water line in the overflow canal so as to obtain the benefit of the syphonic effect, and in this connection is the only valve in the circulating system, for the regulation of the amount of water passed through. A novel overflow canal arrangement has been made in the provision of a by-pass so that in winter the overflow may be directed back into the intake canal to keep the trash racks and screens free from ice. Provision is made for keeping the hot well always filled by an equalizing valve between it and intake well, which will always remain closed when the hot well is full, but will open and admit river water whenever the hot well level drops below the river level.

The officers of the Detroit Edison Company, who have been interested in the development of the new company and the generating station are C. W. Wetmore and W. F. White of New York, who are the president and vice-president, respectively, and Alex. Dow of Detroit, second vice-president and general manager. The equipment of the station was installed under the direct supervision of Geo. W. Cato, superintendent and Thos. Drysdale, chief engineer of the company. Westinghouse, Church, Kerr & Co., engineers for the work, were represented by W. W. Churchill, vice-president, and W. S. Austin, the construction work in the field having been in charge of H. H. Lane. The structural steel work of the building was designed under the special direction of R. A. Marshall, of Westinghouse, Church, Kerr & Co., while the construction work was carried out by Albert A. Albrecht, of Detroit.

SPECIAL TAR MACADAM has been laid on a street of 6 per cent. grade in Ottawa, in order to furnish a good footing for horses. The roadway is 30 ft. wide and contains two street railway tracks laid on a concrete foundation 18 ft. wide and 6 in. thick. Sandstone blocks are placed along the rails. The macadam was laid by first placing a foundation of 2-in. limestone brought up to within 4 in. of the finished surface. On top of this a 3-in. course of 2-in. tarred limestone was laid and consolidated with a hand roller, and then a 1-in. wearing coat of ⅝-in. tarred limestone was similarly placed and rolled. The surface was then dusted with fine limestone and given a final rolling. There is only a slight crown, as the pavement is on a heavy grade.

The Present Status of the Panama Canal.

By Fullerton L. Waldo.

The Culebra Excavation.—On May 24, 1904, the new French Panama Canal Co. turned over all its property to the United States. On May 26, Resident Engineer Harper assumed control; he was relieved Nov. 20, 1904, by Division Engineer W. E. Dauchy. The output was increased from 27,556 cu. yd. in May to 42,935 in December. According to ex-Chief Engineer John F. Wallace, the average yardage cost for the eight months to Dec. 31 was 54.7 cents. The Engineering Committee of the old Isthmian Canal Commission, consisting of Professor Burr, Mr. Parsons and General Davis, says in its report of Feb. 14, 1905: "The former Isthmian Canal Commission assumed in its estimates that the average cost of excavation in the great summit cut would be 80 cents per cubic yard. The demonstrated cost of this Commission's actual work at Culebra, if applied to the quantities employed by the former Commission, would reduce the total estimated cost of the Canal about $15,000,000. This large saving in cost makes a fundamental reconsideration of canal plans by this Commission essential." The total excavation, May 4 to Dec. 31, was 243,472 yd.; to May 1 was 408,680 yd., making a total of about 652,000 yd. for one year's work. In January, 1905, 70,650 cu. yd. were excavated at an average cost of 46.8 cents. Up to Dec. 31, only three steam shovels had been at work. These were 75 to 90-ton affairs, with 5-yd. buckets. An estimate by ex-Chief Engineer Wallace contemplates the installation of 100 steam shovels, with an annual yardage of 30,000,000. (See the Report alluded to above, page 12.) This yardage "may be reached without requiring a greater output per shovel, or greater speed in working, than has already been attained." The labor force at Culebra varied from 364 in October, 1904, to 669 in June, 1905. During December the number of men at work was 543.

ESTIMATES OF COST OF CANAL BY JOHN F. WALLACE.

	Isth. Can. Com. 80-ft. level.	Sea Level	30-ft. Level.	60-ft. Level.
Colon Breakwater	....	$5,000,000	$5,000,000	$5,000,000
Colon Inner Basin	$8,057,707	8,373,000	8,373,000	8,373,000
Entrance	....	1,500,000	1,500,000	1,500,000
Harbor to Bohio	11,099,839	11,099,839	11,099,839	11,099,839
Bohio Locks and Spillway	11,567,000	....	7,000,000	9,000,000
Bohio Dam and Spillway	6,370,000	....	....	5,000,000
Padro Miguel Lock	1,192,000	....	....	6,000,000
Excav., Bohio to Miraflores	50,200,000	125,000,000	86,000,000	59,500,000
Retaining Walls, Culebra	....	10,394,794	10,394,794	10,394,794
Miraflores Lock	5,781,401	4,000,000	5,781,401	5,781,401
Pacific Level	....	12,427,971	12,427,971	12,427,971
Chagres and Gatun Diversion	....	3,000,000	3,000,000	3,000,000
Panama R. R. Diversion	....	1,267,500	1,267,500	1,267,500
Gamboa Dam and Spillway	....	10,000,000	10,000,000	10,000,000
Total		$192,063,104	$161,844,503	$148,344,505
Add 20 per cent. for Administration, etc.		$38,412,621	32,368,901	29,668,901
Grand Total	$144,233,000	$230,475,725	$194,213,406	$178,013,406

By the sea-level plan, there are 186,000,000 yd. still to excavate along the canal route; by the 30-ft. level plan, 142,000,000; by the 60-ft. plan, 111,000,000. The time required, according to Wallace, is 12, 10 and 8 years, respectively. The cost, as stated by the same authority, would be: Sea-level, $230,475,725; 30-ft. level, $194,213,406; 60-ft. level, $178,013,406. The yardage cost of 54.7 cents is deduced from the following figures: Installation of plant, 1.5 cents; mining, 11.2 cents; loading material, 11.0 cents; transportation to dumps, 11.5 cents; dumps, 4.5 cents; maintenance of track, 8.4 cents; general expense, 6.6 cents; average cost, 54.7 cents per cubic yard.

Control of the Chagres.—Besides the great Culebra excavation, the *crux* of the entire Panama Canal project, as is well known, is the control of the floods of the Chagres valley in the rainy season. It is the purpose of this article to deal particularly with this feature of the engineering situation at Panama, and with the recent discoveries of American engineers, headed by Resident Engineer Boyd Ehle, which have led to the practical abandonment of the project for a dam at Bohio, and the substitution of a dam at Gamboa with spillways. The Bohio dam was the darling project of the late George S. Morison, member of the Isthmian Canal Commission of 1901-2. Borings at Bohio reveal that the greatest depth to a rock foundation is 158 ft., which is prohibitive of the projected dam. Had this fact been ascertained ten years ago, with no substitute in sight for a dam at this point, the French engineers having declared it (in 1898) impossible to divert the Chagres floods into the Pacific, it is probable that the Panama route would have been abandoned, and the Nicaragua route chosen. The project of the Gamboa dam with its spillways seems the most rational—perhaps the sole rational—alternative for the dam at Bohio. In their Report of February, 1905, to which reference has been made, the Engineering Committee recommends a dam at Gamboa, with a crest height of about 200 ft. above sea level, in case the Commission decides that the summit level of the canal shall not exceed 60 ft. This decision is based upon the results of surveys made by Resident Engineer Boyd Ehle and his assistants since June, 1904.

The Gamboa Dam.—The Gamboa dam is situated about 47 miles from the mouth of the Chagres, at a river-bed elevation of 43 ft. and 1,500 ft. above the canal crossing at Bas Obispo. The region was mapped (in 5-meter contours) by the French engineers, and pits and borings made in 1881, 1882, 1883, 1890 and 1896. Their borings were made only in soft rock, without the use of core drills. The conclusion they reached was as follows: (French Report, International Commission of Engineers, Nov. 16, 1898): "To turn the stream (Chagres) completely from its course and direct it to the Pacific slope far from the location for the canal, an idea formerly advanced and in part considered, would be a colossal undertaking, requiring an amount of labor which would render it impracticable. It is a solution upon which it does not seem possible to dwell." The result of a very thorough examination by the American engineers, covering the entire area of probable feasibility for the location of a dam, has been to reverse the decision of the French engineers. One hundred and twenty-five holes were driven to the underlying rock.

"In nearly all these holes beyond the river limit the rock has been cored with the diamond drill and the samples preserved. . . . The wash rig equipment consists of a tripod derrick with a wheel drum. One and seven-eighths inch hollow wash rods were used for drilling, through which water was forced by a 2½-in. Rumsey or Gould hand pump. For cutting, a bit was used with four jet holes. In clay or clayey soil it was often possible to run the rods down without casing, but for diamond drill work, and in sand or gravel, 2½-in. casing was used and set into the rock to cut off the flow of sand or outside material. The diamond drill was the ordinary tripod machine, with 1 5/16-in. bit set with six to eight carbons, cutting an annular ring so as to leave about a one-inch core. Usually three wash rigs and one diamond rig were running. . . . For the river work, two rafts were built of balsa wood. One of these, with two large iron buoys, was connected with the lead lines to the deadmen upstream. Side anchors were also used, but the current in the river, generally about 4 ft. a second, proved very trying, and much time was lost on some work by the breaking away of the rafts during the floods, in which the velocity of the current must have reached 8 ft. a second. To the first raft was moored the second, and in the somewhat still water made by the former. On it was placed a tripod derrick and other equipment. A hole about 2 x 3 ft. was used to drill through, and also provided against variations in the river level. . . . Whenever it was possible platforms were built in the river with old rails and were quite serviceable, as this made it possible to use the diamond drill. It was found risky to use the diamond drill from the raft. The 2½-in. casing furnished by the American Rock Drill Co. was very carelessly threaded, and often so far out of center that the female thread which broke was often but one millimeter out of a total pipe thickness of about 6 millimeters. At least six holes were lost by the casing twisting off, as it was often not easy to detect the defect. The tentative scheme of boring at first was at the corner of a 200-ft. square, in order to distribute the acquired data as much as possible until the project developed favorably. As no unfavorable conditions arose, holes were interpolated on the basis of 100 ft. square, and it was intended to have intermediate holes in case of any abrupt change in the rock surface." (Communication to the author by the resident engineer in charge).

The lake area formed by the Gamboa dam would be approximately as follows:

	Square feet.	Acres.	Square miles.
For Ele. 200 ft.	1,206,356,000	27,694	43.3
For Ele. 170 ft.	860,000,000	19,740	30.8
For Ele. 132 ft.	415,000,000	9,527	14.9

The elevation of 200 ft. at the crest may be greater than is necessary; this gives a free board of 23.5 with the greatest flood. A dam with a crest elevation of 185 ft. would give 8.5 ft.—about the usual amount—and cost $500,000 less. The material is largely the Culebra débris, and the cost per cubic yard need not be more than five cents. For a dam with a crest elevation of 200 ft. the section shows a crest width of 20 ft. and a slope of 1 or 2, with a rock-founded core-wall 30 ft. wide to the 70-ft. elevation, and then sloping (1 on 10) to a width of 5 ft. at the top (elevation 193 ft.). The maximum depth to rock is about 52 ft. below low water. No difficulty is anticipated in constructing the core wall in coffer dam by sections.

The head gates of a power plant, with tunnel intakes, are located in the dam at the saddle at the south end, and in the hill forming the northern buttress of the main dam is stationed the gate tower, with tunnel intake, for emptying the reservoir. There are two gates at each of the elevations 44 ft., 75 ft., 100 ft. A large tunnel goes from the well through the solid rock to a point below the toe of the dam.

Near the old spillway are located waste pipes (elevation 132 and 142 ft.) having a total capacity equal to the tunnel wasteway. In the spillway is a dam to create a lake at elevation 125 ft. to act as a cushion to take up the impact of the water dropping 50 or 60 ft. to this level. There is a gate-house for the pipes on the north side of the ridge near the pond; the pipes will have 25 ft. back pressure. At the north end of the spillway the tunnel and weir have Stoney gates with sill at 150-ft. elevation. The weir discharges along the side of the channel into the pond. A concrete wall protects the dam toe at the pond. The dam forming the pond will be a concrete weir. The water flowing over the weir passes along the canal to the diversion channel; smaller weirs to check the current might be built below the main weir.

The estimate for the Gamboa dam is as follows:

Crest at El. 200 Ft., Length on Crest About 5,700 Ft.

	Cu. Yd.	Total
2,700,500 cu. yds. embankment........	$0.05	$135,025
259,400 cu. yds. concrete............	8.00	2,075,200
104,300 cu. yds. earth ex., for core wall below river level..................	1.00	104,300
90,000 cu. yds. earth ex. below river level	0.75	67,500
28,600 cu. yds. rock ex., mostly soft rock	1.25	35,750
Total		$2,417,775

Differences for Dam at El. 185 Ft. Length on Crest About 4,230 Ft.

	Cu. Yd.	Total
648,000 cu. yds. less embankment......	$0.05	$32,400
65,900 cu. yds. less core	8.00	527,200
19,000 cu. yds. less earth excav......	0.75	14,250
6,000 cu. yds. less rock excav.........	1.25	7,500
Total		$581,350

Cost of Dam at El. 185 Ft., Adding 20% for Engineering Work and Contingencies.

Dam at Ele. 200 ft.........................	$2,901,330
Dam at Ele. 185 ft.........................	2,203,710
Mr. Morison's estimate for Alhajuela Dam..	3,600,000
New French Co.'s estimate for Alhajuela Dam	2,713,000

With the limiting height for the Gamboa dam at 200 ft. the design for the spillways to divert the Chagres floods above Gamboa places the tunnel at El. 175 ft. with the bottom at 145 ft. The tunnel to the Pacific would have a length of 41,000 ft. (7¾ miles); the tunnel through the Gatuncillo divide to the Atlantic would be 23,000 ft. in length (4 1/3 miles). The concrete-lined tunnel would have a segmental arch roof of 28 ft. span, with a rise of ¼ and height from invert of 28 ft. The hydraulic data are: Area, 707 sq. ft.; wetted perimeter, 99.5 ft.; hydraulic radius, 7.1; discharging capacity at ordinary lake level, 6,200 sec.-ft. The grade of the spillway being at 132 ft., the maximum flood elevation would reach 176.5 ft. (23.5 ft. below dam crest). With the dam at El. 200 ft., the storage capacity of the basin above 176.5 ft. would be 16,120,000,000 cu. ft. (to the height of the great flood at 192 ft.). This would permit inflow at the very high rate of 11,000 sec. ft. for 23½ days.

An estimate for the Gatuncillo and Pacific Spillways is as follows:

Gatuncillo Spillway.

612,000 cu. yds. Rock Ex. in tunnel...	$4.00	$2,448,000
141,480 cu. yds. Concrete lining.......	10.00	1,414,800
500 lin. ft. Shaft......................	50.00	25,000
190,000 cu. yds. Rock Excav..........	1.15	218,500
50,000 cu. yds. Earth Ex................	0.50	25,000
Controlling works at intake...........		40,020
Proportion in diversion channel at lower Gatun to Manzanillo Bay............		250,000
Total (about)		$4,421,320

Pacific Spillway.

1,436,160 cu. yds. Rock Ex. in tunnel...	$4.00	$5,744,640
332,000 cu. yds. Concrete lining.......	10.00	3,320,000
500 lin. ft. shaft......................	50.00	25,000
300,000 cu. yds. rock excav...........	1.15	345,000
Controlling works at intake (about)....		55,360
Total (about)......................		$9,490,000

The proposed plan for the electric power development contemplates gates in the dam at the south end, with 12-ft. riveted steel penstocks leading thence to a power-house at a distance of 800 ft., at a tailbay connecting with the canal. The power house, containing all dynamos, motors, transformers, governors, switchboards, etc., is 80 x 400 ft.; a distributing pipe to the turbine, with gates, is located there. About 3,000 sec.-ft. should be available for power purposes (ordinary lake level 160 ft.; low level, 132 ft.). The horse power at the shafts (80 per cent. efficiency) would, therefore, be as follows for the various types of canal:

Canal type..............	Sea lev.	65-ft.	85-ft.
Max. head	160	95	75
Min. head	132	67	47
Max. h.-p.	43,600	26,000	20,500
Ave. h.-p.	39,800	22,150	16,650
Min. h.-p.	36,000	18,300	12,800

The estimate for power development is as follows:

285,000 cu. yds. Excav..............	$0.80	$228,000
5,500 cu. yds. Concrete	7.00	38,500
1,600,000 lbs. Pipe.....................	.05	80,000
Power House..........................		530,000
Gates		20,000
Equipment for 50,000 hp...............		2,250,000
Total for sea-level plan.............		$3,146,500
Total for 65-ft. level plan..........		$2,010,000
Total for 85-ft. level plan..........		$1,750,000

The ex-Chief Engineer, Mr. John F. Wallace, in his report dated Feb. 1, 1905, summarizes critically the Gamboa Dam and spillway investigations of Mr. Ehle and his party, and comments upon the project for the installation of an electric power plant. He says:

"The essence of the results of Mr. Ehle's investigations is as follows:

"1. That the construction of a dam up to the height of 200 ft. at Gamboa is practicable and economical, the bed-rock being found at an elevation of approximately the level of the sea and the configuration of the ground above the sea level giving a cross-section of the valley of moderate and reasonable dimensions at this point. The situation admits of the construction of a solid core of masonry from the bed-rock to the crest of the dam at an elevation of 200 ft. above sea level, or at whatever elevation may hereafter be determined upon, and the reinforcement of this central core with the broken rock and other debris from Culebra cut. When it is considered that the distance between the center of gravity at Culebra cut and Gamboa dam is within the limit of the average haul necessary for the disposal of the large amount of material to be removed, the economy of the construction of this dam is apparent.

"2. That it is possible to construct a tunnel spillway either through the Continental Divide on to the Pacific slope with a maximum tunnel length of 8 miles, or a tunnel spillway on to the Caribbean slope with a maximum tunnel length of 3½ miles.

"3. That the approximate area of the reservoir contained by a dam at Gamboa would range from a minimum of 15 sq. miles at a water elevation of 132 ft. above the sea, to a maximum approximate area of 43.3 miles with an elevation of 200 ft. This, in connection with other data obtained by Mr. Ehle, clearly demonstrates the fact that the construction of a dam at Gamboa will satisfactorily and economically solve the problem of the control of the Chagres River, the provision of water for any low level lock canal designed, and the supply of sufficient electric energy for lighting purposes, railroad operation, or the operation of machinery used in the construction of the canal; and, incidentally, a water supply for the towns and villages situated along the line of the canal, and for the supply of the work.

"However, the Chief Engineer considers that a more ample allowance should be made for the works outlined above, and would suggest that not less than $5,000,000 be considered the cost of the Gatuncillo tunnel, including the increase in the cross-section of the river diversion between Gatun and the bay east of Colon; and that $12,000,000 be allowed for the Pacific tunnel spillway. He would also suggest that at least $5,000,000 be allowed for the construction of the Gamboa dam and the auxiliary works, not including the power plant. For the provision of electric power plant with all the auxiliaries connected therewith, on the basis of 20,000 h.-p., he would suggest an estimate of $3,000,000. This, on the basis of the Gamboa dam being constructed to an elevation of 200 ft., would give estimates as follows: 1. The Gamboa dam, including the Gatuncillo spillway, and enlargement of the Gatun diversion, $10,000,000. 2. The Gamboa dam, including the Pacific spillway, $17,000,000.

"Should either one of these plans be adopted, and the establishment of an electric power plant receive consideration, $3,000,000 should be added to the estimate. While there is no question but that the installation of an electric power plant at this time would be justified, it should not be considered a determining factor in the solution of this problem. As it would require from two to three years to construct the dam and install such a power plant, the work of canal construction would at that time be so far advanced that it is not considered that its installation would cause such saving in the construction, operation and maintenance of the canal as would justify any considerable expense beyond the mere cost of installation of the plant after the construction of the dam with its auxiliary spillways shall have been determined upon. In other words, the advisability of the construction of the Gamboa dam with its auxiliary works should be determined upon irrespective of the electric energy to be obtained therefrom. This latter question should only be considered in connection with the expenditure necessary for that particular purpose."

Other Dam Sites.—While the main excavations at Culebra and the Gamboa surveys were being actively prosecuted, a party under Mr. A. B. Nichols, Assistant Engineer, was making examinations and trial borings at Gatun to determine the practicability of a dam across the Chagres valley at that point, to form a lake at the 60-ft. level. The conclusion reached was that no satisfactory foundation of bed rock for a dam will be found anywhere north of Bohio, at any depth less than 163 ft. Borings were made in the vicinity of Gatun to a depth of 175 ft. without discovering solid rock. Mr. Nichols also investigated a cut-off—the Tiger Hill Cut-off—for an alternative location of the canal axis between Bohio and Gatun. The abbreviation of the route does not seem to justify the greatly increased expenditure due to the great amount of rock excavation necessitated, and the fact that the canal would have to be carried, for a portion of the length, through a swamp between embankments, as at Nicaragua.

Mr. Dose, Resident Engineer at Bohio, examined two suggested dam sites, using a diamond drill; the conclusion reached (see Chief Engineer's report of Feb. 1), was "that there is little probability of finding a satisfactory location for a high dam in this vicinity, as the rock gorge in this locality is from 163 to 168 ft. in depth and is filled with an alluvial deposit consisting of clay, gravel, sand and drift wood, the material down to 150 ft. at least being very porous and freely water-bearing." On one line, the minimum depth to solid rock suitable for a foundation is 163.6 ft. below sea level; on another line 168.3 ft., and on a third, 142.4 ft. At a point called Buena Vista, further up the Chagres Valley, between kilometres 25 and 26 of the French canal-route divisions, borings revealed rock at 130 ft., but as the borings proceeded, along a line projected across the valley, "each new hole has shown the rock at a deeper elevation than the preceding one, indicating a sharp inclination of the bed-rock towards the center of the valley. The probabilities are that the depth of the bed-rock will be located at a much greater depth."

Sea-Level or Lock Canal.—In Mr. Wallace's opinion, the key to the whole problem at Panama is the Culebra excavation, extending over a length of 7½ miles on the basis of a canal with 90-ft. summit level, and 10 to 14 miles with 60-ft., 30-ft. or sea-level. The summit level should not exceed 60 ft.; a 30-ft. level, as compared with a 90-ft. level, will eliminate four costly locks and a dam difficult of construction; as compared with a 60-ft. level, two locks are eliminated, and the ultimate reduction to sea-level is materially simplified; as compared with the sea-level plan, one additional lock is needed, since even with a sea-level canal one lock is required on account of the difference in the tides at the opposite sides of the Isthmus. The emphatic preference of the Chief Engineer is, however, for a sea-level canal.

At a meeting of the Engineering Committee of the Isthmian Canal Commission, held Feb. 14, confirming the judgment of the Chief Engineer, it was unanimously "Resolved, That this Committee approve and recommend for adoption by the Commission a plan for a sea-level canal, with a bottom width of 150 ft. and a minimum depth of water of 35 ft., and with twin tidal locks at Miraflores, whose usable dimensions shall be 1,000 ft. long and 100 ft. wide, at a total estimated cost of $230,500,000."

Their opinion with regard to the dam at Gamboa is given in their report as follows: "Work on the foundation for the dam at Gamboa can be begun at once. This portion of the construction of the dam will probably require from a year to a year and a half of time, and it is the unanimous judgment of the committee that it should be undertaken immediately, and that the construction of the entire dam should be completed as soon as practicable. The building of the dam at Gamboa will not only furnish complete and effective means of control for the Chagres floods, but it has the further advantage of being entirely accessible by the Panama R. R. for the transportation of men and materials. The plan of the dam will probably require a masonry core, with a great mass of earth and rock fill on either side of it, from the waste excavation of the summit cut. The plan, therefore, has marked merits of both efficiency of control and economy of construction. The conditions attending the construction of this dam are in no way unprecedented. The depth of bed-rock below water surface is only about one-third that at Bohio and no greater than has already been reached by the use of heavy timber sheet piling for founding masonry structures in the United States. The proposed height of this dam from its foundation to its top is far less than found in a number of masonry dams already built, and the making of the earth embankments on the two sides of the masonry core is simply wasting the material from the summit cut. The construction of the Gamboa dam, therefore, involves no formidable obstacles not heretofore successfully encountered in engineering practice. The practicability of certainly and satisfactorily controlling the floods of the Chagres by so simple and economical a method as the Gamboa Lake and its outflow channels, and the reduced cost of excavation as actually demonstrated by the work of the Commission in the Culebra cut, makes the construction of a sea-level canal at a reasonable cost far more available than has heretofore appeared possible. These recent developments in the conditions attending the construction of the canal are so important as to be almost controlling in character. The remaining element is that of the time required to make the great summit excavation (at Culebra)."

As indicative of the conditions under which the engineering work is done it might be added that the instruments of one of the engineers whose work made the above report possible, were held in the government storehouse at Colon for six weeks after his arrival on the Isthmus, and personal appeals and begging letters to the authorities were of no avail to dislodge them. It becomes increasingly evident that the work of the engineer in the field is not facilitated but often seriously hampered by the War Department administration, with its elaborate routine of circumlocution and bureaucracy. The petty official orthodoxies have no place on a great engineering work; every available foot-pound of energy must be devoted to getting the big ditch dug.

The Pressure of Grain on Bin Walls.

The pressure of grain on the walls of a bin was tested by Mr. Max Toltz prior to designing a large elevator at West Superior. A bin 14 ft. square and 65 ft. deep was lined with sheet steel. In one of the walls near the bottom a 3 x 1½-ft. hole was cut and in the opening a steel plate was placed, which was held rigidly at the two ends by a frame constructed of steel channels, but left the top and bottom edges free; the bin was then gradually filled with grain, carefully taking the deflection of the plate for the different heights of grain. The process of filling and emptying the bin a considerable number of times was repeated, using different thicknesses of plates, starting with No. 12 gauge and then reduced to 15, 18 and 22 gauge. Separate tests on the plates with known loads producing the same amount of deflection were made and it was found that the lateral pressure, either when filling or emptying the bin, did not exceed 3 lb. per square inch. This result is in line with Mr. J. A. Jamieson's conclusions from experiments described by him in detail in a paper before the Canadian Society of Civil Engineers. He decided that the proportion of the weight of grain in a bin that will be carried by the walls, and by the bin bottom, and therefore the intensity of both the vertical and lateral pressures produced by the grain, is dependent on four factors, as follows: (1) The angle of internal friction of the grain mass or the ratio of lateral to vertical pressure. Having ascertained the angle of internal friction for wheat weighing 50 lb. per cubic foot to be 28°, it is readily found that the ratio of lateral to vertical pressure must be 0.6. (2) The co-efficient of friction between the grain mass and the bin walls. As the co-efficient of friction between wheat and the bin walls built of various materials will vary from 0.375 to 0.468, 0.41667 may be taken for the mean value. (3) The ratio of the area of the bin walls to the horizontal area or weight of the grain column, set by the dimensions of the bin to be calculated. (4) the ratio of the diameter to the height of the grain column, set by the dimensions of the bin to be calculated. He states that the pressures produced by grain in deep bins are only a small part of the pressures that would be produced by a fluid of the same specific gravity.

Vertical-Shaft Outward-Flow Turbines of the reaction type, operating under 265 ft. head, are used in a small plant in Central New York, according to Mr. C. A. Greenidge. Five-eighths of the weight of the revolving parts are supported by the water pressure, and the remainder is carried by a flat step-bearing through which 4 gal. of oil per minute are circulated under a head of about 30 ft. During the last 3 years this plant has been in almost constant operation with an average load for 1903 of 65 per cent., and for 1904 of 70 per cent. of the rated capacity. Thus far the step-bearings have given no trouble; in fact there has been little occasion for examining them. The first wheels installed were of foreign design, but after being in operation for about a year they proved unsuitable and were replaced two years ago by wheels of American design. Although they have been in almost constant operation the tool-marks are still visible, proving that under this head a vertical-shaft reaction turbine can be worked satisfactorily. The only place where any wear takes place is in such parts as have been partly clogged by pieces of wood, which causes a high velocity in the open portion. These wheels showed on test an efficiency of at least 76 per cent. at full gate.

Variations in Standard Plans for Railroad Plate Girders.

By Frank W. Skinner, M. Am. Soc. C. E.

In the preparation of the portion of the writer's work on "Types and Details of Bridge Construction," devoted to standard plate girder designs, the variation in many details of structures for the same service on different railroads was found to be surprisingly great. As there is no technical reason for such a great variation, a summary of the conditions relating to web stiffeners is here presented as a matter of general interest. The requirements in the specifications of a number of the most important railroads, bridge shops and bridge engineers are quoted exactly in some, but in most cases are rearranged or condensed without modifying their meaning.

American Bridge Co., 1900, C. C. Schneider, vice-president.—The web shall have stiffeners riveted on both sides, with a close bearing against upper and lower flange angles at the ends and inner edges of bearing plates, and at all points of local and concentrated loads, and also, when the thickness of the web is less than 1/60 of the unsupported distance between flange angles, at points throughout the length of the girder, generally not farther apart than the depth of the full web plate, with a maximum limit of 5 feet.

Atchison, Topeka & Santa Fe Ry., 1902, A. F. Robinson, bridge engineer.—When the thickness is less than 1/80th the unsupported depth web stiffeners shall be spaced 1½ times the depth.

Baltimore & Ohio R. R., 1904, J. E. Greiner, engineer of bridges.—The two pairs of end stiffener angles and fillers shall be proportioned to take the maximum end shear. Intermediate stiffeners, in pairs, shall be spaced at all concentrated loads, and at a distance about equal to the depth of the girder or a maximum of 6 ft. The size of the stiffener angles shall increase with the depth of the girder, 3½ x 3½ x ⅜-in. for a 6½-ft. girder, 5 x 3½-in. for 7 to 7½-ft. and 6 x 4 x ⅜-in. for 8 ft. and over.

Chicago, Milwaukee & St. Paul Ry., 1904, C. F. Loweth, engineer of bridges and buildings.—All shop-riveted stiffener angles must bear tightly against top and bottom flange angles. Filler plates with ends bearing against flange angles must be used under end stiffener angles. Intermediate stiffener angles shall preferably be offset, except that fillers may be used under angles connecting floorbeams to girders, in which case fillers must bear on bottom flange angles but may have ⅞-in. clearance at top.

Boston & Maine R. R., 1896, J. P. Snow, bridge engineer.—Stiffeners at bearings and at top flange concentrated loads may be fitted to top flange and assumed to take 8,000 lb. load per square in. of contact surface where it is not convenient to secure sufficient rivet bearing strength, otherwise there shall be ⅛-in. to ¼-in. clearance between the flanges and the ends of the stiffeners. The rivet pitch in stiffeners shall not be greater than in the adjacent portions of bottom flanges.

Choctaw, Oklahoma & Gulf R. R., 1902, Boller & Hodge, consulting and designing engineers.—All stiffeners have fillers and are milled at the ends to fit flange angles. They are placed over bearings and at concentrated loads and are spaced not farther apart than the depth of the girder near the ends nor more than twice the depth of the girder apart near the center.

Canadian Pacific Ry., 1903, C. N. Monserrat, engineer of bridges.—Stiffeners shall be spaced about the depth of the girder wherever the shearing stress per square inch is greater than 12,000 $\div [1 + (H^2 \div 3{,}000)]$, where H is the ratio of the depth to the thickness of the web.

Chicago Great Western Ry., 1904, A. Münster, bridge engineer.—Stiffeners at end bearings and at all points of concentrated loading shall be proportioned as columns to carry the total shear and provide amply for its distribution into the web.

Cleveland, Cincinnati, Chicago & St. Louis Ry., 1901, G. W. Kittridge, chief engineer; C. B. Clark, principal assistant engineer.—At the end bearings two pairs of stiffener angles with fillers and included portion of web shall have a column section sufficient for the maximum shear. Where the unsupported depth of web exceeds 50 times its thickness intermediate stiffener angles in pairs will be put at points of concentrated loading, at web splices and at cross frames, and will have a maximum spacing of 5½ ft. or equal to the depth of the girder in the middle or one-half that distance at the ends. Intermediate stiffeners shall be crimped except at floorbeams, cross frames, etc. Sizes vary with depth of girder, from 3½ x 3½ x 5/16-in. for 4 ft. and under to 4 x 3 x ⅜-in. from 4 to 7 ft. and 5 x 3 x ⅜-in. for girders more than 7 ft. deep.

Theodore Cooper, consulting engineer, 1901.—Stiffeners at end bearings to have fitted ends. Intermediate stiffeners to be used at points of concentrated loading and spaced not farther than the depth of the girder nor a maximum of 5 ft. where the shear per square in. exceeds 10,000-75 times ratio of depth of web to its thickness. All stiffeners are proportioned to carry maximum shear with a unit stress of 10,000-45 (1÷r), where 1 is the length of stiffener and r is radius of gyration. The web rivets in each stiffener are proportioned for the maximum shear.

The King Bridge Co., 1898.—Stiffeners with fitted ends at end bearings, points of concentrated loading and spaced about the depth of the girder wherever the maximum shear per square in. exceeds $12,000 \div [1 + (d^2 \div 3,000t^2)]$, where d is the depth between flange angles and t is thickness of web. Intermediate stiffeners crimped for girders more than 30 in. deep. The sizes of the stiffener angles increase with the depths of the girders as follows: For girders up to 5 ft. deep, with 5-in. flange angles, 4 x 3 x 5/16-in. end stiffeners, and for 6-in. flange angles, 5 x 3 x ⅜-in. end stiffeners; intermediate stiffeners, 3½ x 3 x 5/16-in.; for 5-ft. to 7-ft. girders, 5 x 3½ x ⅜-in. end stiffeners, and 4 x 3 x 5/16-in. intermediate stiffeners; for girders more than 7 ft. deep, 5 x 3½ x 7/16-in. end stiffeners, and 5 x 3 x 5/16-in. intermediate stiffeners.

New York Central & Hudson River R. R., 1904, W. J. Wilgus, chief engineer; Olaf Hoff, engineer of structures.—Stiffeners with fillers at the end bearings, at all points of application of concentrated loads and intermediate stiffeners with a spacing of

$$60\ t\sqrt{\left(\frac{12,000}{s} - 1\right)}$$

where s is the shear in pounds per square in. of gross area of web plate, and t is the thickness of the web. The intermediate stiffeners may be omitted if this spacing is greater than the clear distance between girder flange angles. The end stiffeners have their cross section proportioned for the maximum bearing stress. The maximum distances between stiffeners must not exceed 6 ft.

Osborn Engineering Co., 1903.—Pairs of stiffeners and fillers at both edges of end bearings, at concentrated loadings and intermediately at maximum distances of 6 ft. spaced so the shear per ft. shall not exceed $20,000 \times 12\ t \div [1 + (d^2 \div 3,000t^2)]$, where t is the thickness of the web and d is the distance between its supports. Intermediate stiffeners shall be used where the ratio of unsupported depth of web to thickness is greater than 50.

Phoenix Bridge Co., 1895, John Sterling Deans, chief engineer.—Stiffeners with milled ends at bearings and points of concentrated loading and intermediate stiffeners spaced the depth of the girder where the shear per square in. exceeds $12,000\ [1 + (H^2 \div 3,000)]$, where H is the ratio of depth of web to thickness.

The Philadelphia Rapid Transit Co., 1904, C. M. Mills, assistant engineer in charge of bridges.—Stiffeners shall be in pairs with their ends fitted to the girder flange angles. End stiffeners shall be proportioned so that the stress from the maximum shear shall not be greater per square in. on their cross sectional area, including that of the portion of the web between them, than is allowed in the top flange of the girder. Stiffeners will be placed at concentrated loads and intermediately at a maximum distance of 5 ft. or of the full depth of the web plate where the thickness of the latter is less than 1/60 of its unsupported length between flange angles.

Philadelphia & Reading Ry., W. Hunter, chief engineer.—Pairs of web stiffener angles, with fillers shall be spaced the depth of the girder where the thickness of the web is less than 1/30 the distance between flange angles. Over each bed plate there shall be two pairs of stiffeners with a combined cross sectional area equal to the total end shear, including impact, ÷ 15,000. All stiffeners shall have the ends fitted to the flange angles. Sizes of stiffener angles shall vary from 3 x 3 x ⅜-in. for 30-ft. girders to 5 x 3½ x ⅜-in. for 90-ft. girders.

Southern Ry. Co., 1902, D. W. Lum, chief engineer of maintenance of way.—Stiffeners with fillers fitted tightly to flange angles at concentrated loads and intermediately spaced less than the depth of the girder or a maximum of 5 ft. where the thickness of the web is less than 1/60 the distance between girder flange rivets. The sizes of the intermediate stiffener angles are governed by the ratio of the depth of the web to its thickness; for ratios of 60-150 the stiffeners are, 3½ x 3½ x ⅜-in.; for 150-220, 4 x 3½ x ⅜-in.; for 220 and over, 5 x 3½ x ⅜-in. There shall be at least two pairs of stiffeners at the end bearings which, with their fillers, are proportioned for the maximum end shear. Their rivet pitch must not be more than 1½ times the flange rivet pitch at the ends, nor more than 5 in.

Union Pacific R. R., 1904, J. B. Berry, chief engineer.—At each end bearing two pairs of stiffeners proportioned for maximum shear; stiffeners at concentrated loads and intermediately spaced the depth of the girder wherever the ratio of unsupported depth of web to its thickness exceeds 50.

Pennsylvania Lines West of Pittsburg, 1897, J. C. Bland, engineer of bridges.—All stiffeners to support the full width of flange angles and to have fillers. Stiffeners to be placed at both ends of bearing plates and at all web splices, and intermediately at distances equal to height of girders, except at ends where they shall be spaced ½ height of girder when the unsupported distance between flange angles exceeds 50 times the thickness of the web plate.

Erie R. R., 1900, M. R. Strong, engineer of bridges.—Where the thickness of the web plate is less than 1/60 of the unsupported distance between flange angles, stiffeners shall be riveted on both sides of the web 3 ft. apart for girders less than 3 ft. deep, and for deeper girders, about the depth of web plate up to a maximum of 6 ft.

Michigan Central R. R., 1904, B. Douglas, bridge engineer.—Stiffening angles shall be placed at the ends of the girders and at concentrated loads, designed to carry the entire loads at these points. Intermediate stiffeners shall be placed not more than 4 ft. apart at the ends or 8 ft. at the center. Stiffener angles shall be closely fitted to the bottom flanges of the girders at all bearing points and to the top flanges throughout. Filler plates shall be fitted to the flange angles at all bearing points.

Lake Shore & Michigan Southern Ry., 1904, S. Rockwell, assistant chief engineer; R. H. Reed, general bridge foreman.—Stiffeners, fitted to the flange angle fillets are placed at the end bearings and at concentrated loads. Intermediate stiffeners spaced a maximum of 5 ft. or the depth of the girder in the middle and ½ the depth at the ends are required where the unsupported distance between flange angles is more than 50 times the thickness of the web plate. The sizes of intermediate stiffener angles vary with the lengths of the angles from 3½ x 3½ x ⅜-in. for girders up to 50 ft. to 4 x 3½ x ⅜-in. for 50 to 70-ft girders, 5 x 3½ x ⅜-in. for 70 to 90-ft. girders and 6 x 3½ x ⅜-in. angles for girders more than 90 ft. long.

Wabash R. R., 1905, A. O. Cunningham, bridge engineer.—Web stiffener angles shall be in pairs and those at end bearings shall have fillers and shall be fitted to bearing against the flanges. Intermediate stiffeners may have fillers or be crimped; their outstanding legs shall be not less than 1/30 the depth of the girder plus 2 in. All stiffeners shall have a thickness of not less than ⅜-in. and a rivet pitch or not more than 5 in. Intermediate stiffeners shall be placed at concentrated loads and at such points as are required by the formula, shearing stress per square in. of gross section of web = 12,000 — 40 (d ÷ t), where t is thickness of web and d is distance between stiffeners. Where stiffeners carry load directly their web-connection rivets are proportioned to transmit it all, and their cross sectional areas are determined by the formula, Unit stress =16,000 — 70 (1 ÷ r) where 1 is length and r is least radius of gyration. The effective length is assumed to be ½ the actual height of the stiffener. These dimensions shall not be less than the minimum dimensions previously given.

The Specific Heat of Gases.

The specific heat of gases at high temperatures has been investigated by Messrs. L. Holborn and L. W. Austin, who give an account of their work in the "Physical Review." The gas was heated electrically in a nickel tube filled with coarse nickel filings and then passed into a silver calorimeter. The temperature within the nickel tube was measured by a thermoelement and another thermoelement was used at certain stages of the work to make sure that the gas actually issued from the calorimeter at the calorimeter temperature under all conditions. Special precautions were taken to keep the gas at the same temperature when entering the calorimeter that was observed in the nickel tube. For temperatures between 20° and 800° cent., the specific heat of CO_2 was found to be about $0.2028 + 0.0001384t - 0.000000005t^2$. For nitrogen, the mean of the observed values between 20° and 440° was 0.2419, between 20° and 630° 0.2464, and between 20° and 800° 0.2497. The mean result for oxygen between 20° and 440° was 0.224 and between 20° and 630° 0.23. For air the result between 20° and 440° was 0.2366, between 20° and 630° 0.2429, and between 20° and 800° 0.243. It will be noticed that the mean values for nitrogen and air show an increase of 3 per cent. Messrs. Holborn and Austin believe that it is hardly possible to conclude with certainty from these small changes in the experimental results that the specific heat for these two gases really increases with the temperature.

THE POINT OF EXPLOSION in gas engines has been investigated by M. J. Patin, who reports the following conclusions in the "Genie Civil." The "advance of the firing point" is merely the time necessary to overcome the inertia of the moving parts of the engine. This advance depends on the design and arrangement of such parts. In order to obtain the maximum output the firing point must be advanced as the speed increases.

Recent Work on the Indiana Harbor R. R. —II.

The country from Kentland to within 6 miles of Danville is a succession of long, low rolls with comparatively level stretches between them and the heavy cut and the long fill just south of Kentland is typical of the nature of much of the work that is required at each summit to maintain the established grades. These cuts are being made in most cases with steam shovels working in connection with narrow-gauge dump car trains, which haul the material out on pole trestles at one end or the other of the cut to make fills. The grading in the more level stretches between the summits is being handled by slip and wheel scrapers, or by four-wheel dump wagons working with grading machines drawn by traction engines.

The long fill just mentioned ends at Mile 72, and then the grade begins to slowly rise again reaching a summit in Mile 76, with grades and scraper work in between. In Mile 77 a 55-ton Vulcan steam shovel is making two cuts which aggregate 80,000 cu. yd. and the material excavated by it is hauled to Miles 78 and 79 in three fourteen-car trains of 3-yd. Western dump cars, drawn by Porter engines. Several grading machines and a large number of teams are at work in the next 13 miles where the work is comparatively light. A material distributing yard has been established south of the crossing of the Lake Erie & Western R. R. in Mile 81 and track-laying material is being received in large quantities in this yard.

The next big steam shovel cut is at the end of Mile 95 where in 3,000 ft. a cut containing nearly 130,000 cu. yd. has to be made. The material from this cut is being used in making a fill to the south and one to the north, the excess material being wasted to the north by widening the bank.

Undergrade Crossing of the Chicago & Eastern Illinois R. R.

Temporary Trestle over Salt Fork of the Vermilion River.

The progress made in this cut is indicative of the rapidity with which the steam shovel work is being carried on. A 70-ton Bucyrus shovel is working here against a face averaging 18 ft. in height. The material is being removed in trains of 3-yd. Western dump cars hauled by narrow-gauge Porter locomotives, and is dumped from pole trestles, the average haul being approximately ¾ miles. This outfit removed 32,000 cu. yd. of material during August in 23.5 working days of 11 hr. each, 3.5 days being lost on account of rain and no work being done on Sunday. Two and a half miles south of this cut in Mile 98 is another steam shovel cut of 55,000 cu. yd. in which good progress is also being made. A 65-ton Vulcan shovel is at work in this cut working against an average face of about 10 ft. The material is being utilized in a fill to the south, which is being made from pole trestles, the average haul being about a mile. Three trains made up of Porter locomotives and 3-yd. Western dump cars are handling the material between the shovel and the fill. This outfit handled 30,000 cu. yd. in 23.5 working days of 11 hr. each.

The line enters the valley of Stony Creek shortly after leaving this last steam shovel cut and from the entrance into that valley until the junction with the Peoria & Eastern division of the Cleveland, Cincinnati, Chicago & St. Louis R. R. is reached in Danville, the grading is very heavy, especially in the last 3 miles. The ground falls away rapidly to the south and in the vicinity of Danville the country is very roughly broken up. It has generally been conceded that it was not feasible to attempt to construct a line with low grades through this territory at anything less than a prohibitive cost. The line has been located, however, without exceeding the maximum northbound grade of 12.5 ft. to the mile and without excessive cost.

The grading in the first 3 miles down the creek valley is being handled by four-wheel dump wagons working in connection with grading machines drawn by traction engines. In one place where the haul is excessive a narrow-gauge track has been laid and the dump wagons discharge through a trap built over the track into 1½-yd. cars, which are drawn on the track by mules. The Chicago Southern R. R. is crossed by an undergrade crossing near the beginning of mile 105 and the grading work in this and the mile beyond is quite heavy.

The last 3 miles of the entrance into Danville is the most interesting part of the whole line. A cut of 135,000 cu. yd. in a distance of 2,000 ft. is encountered at the upper end of this portion of the line, and about ¾ mile south of the middle portion of this cut is an undergrade crossing of the Chicago & Eastern Illinois R. R. The two tracks of this road had to be elevated 8.5 ft. in order to give sufficient clearance over those of the Indiana Harbor R. R. The condition of the grade line on the old road at this point was such that the elevation had to be carried on for a mile to avoid increasing the grades of its tracks, and in this manner a parallel grade was established which started farther back at each end than the old grade started.

A 70-ton Bucyrus steam shovel, working in connection with trains of 3-yd. dump cars, made in the shops of the MacArthur Bros. Co. and operated by a Vulcan and 3 Davenport engines, was put in operation in the big cut north of the railroad crossing. The north one of the two tracks of the Chicago & Eastern Illinois R. R. was then abandoned and all the traffic on that road diverted to one track. The rails and ties of the standard-gauge track were then removed and a pole trestle built up to the new grade line on the north half of the embankment, which was about 18 ft. high, and a narrow-gauge track laid on the trestle. The construction track was carried over the intersection with the new road on blocking built up on rows of piles driven transversely in the embankment of the old road. The track on the trestle was then connected by a switchback to tracks leading from the steam shovel in the cut to the north, the interior angle between the old and the new roads at the intersection being about 35 deg. Half of the embankment of the old road was elevated to the new grade line with material from the steam shovel cut and preparations are now being made to divert the traffic of the old road over the new embankment and elevate the second track in a similar manner. It will be necessary, however, in elevating the second track to carry the construction tracks through the opening made in the embankment of the old road for the new line and then build a switchback connection on that side of the embankment. The change of grade of the tracks of the old line will require a fill containing 63,000 cu. yd. of material, all of which has to be placed so the work will not interfere with the heavy traffic of that road.

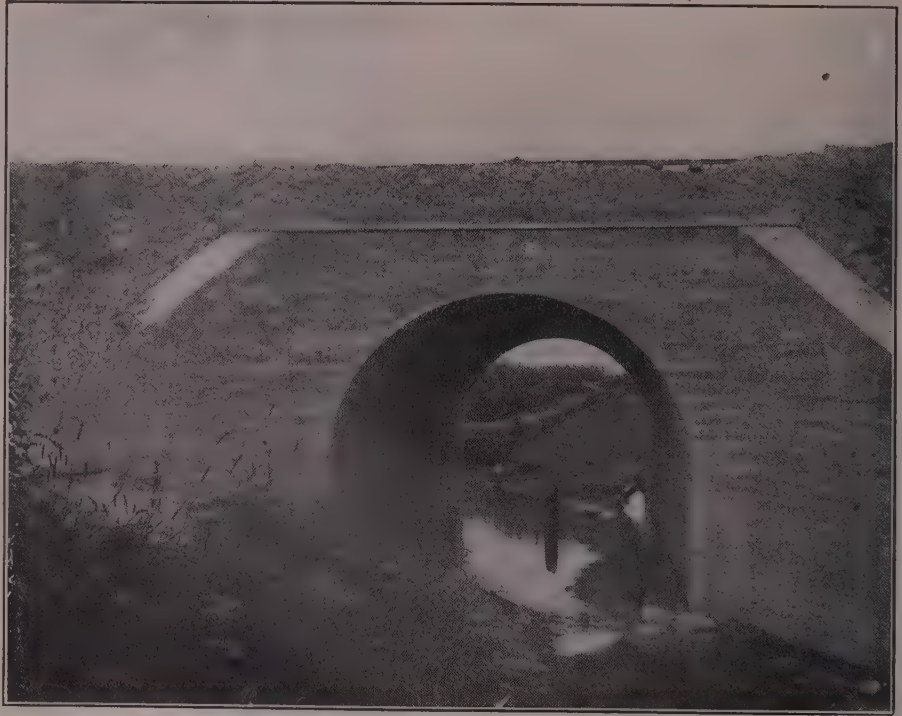
The last two miles of the line are estimated to require 375,000 cu. yd. of material in embankment and excavation to bring the tracks to their connection with the Peoria & Eastern division in Danville. Two 75-ft. span plate girder creek crossings, two overhead highway crossings, the changing of the creek channel, involving about 15,000 cu. yd. of excavation, the building of one new highway bridge over the altered creek channel and the moving of another also have to be undertaken as a part of the work in this distance. One of the creek crossings is on a skew and the abutments for it are built parallel with the creek, but the bridge seats are so arranged that the girders are built without the skew.

The largest single pieces of work on this part of the last two miles are a cut from which 140,000 cu. yd. of material have to be removed and a fill just below it of 180,000 cu. yd. The cut is being made by a 65-ton Bucyrus steam shovel, and the excavated material hauled out and dumped from a pole trestle over the fill, which is 40 ft. high in places, in 12-car trains of 3-yd. Western dump cars, hauled by narrow-gauge Porter engines. The connection with the Peoria & Eastern division is made a short distance beyond this fill.

The nature of the country through which the line passes requires an unusually large number of waterways through the embankments. The smaller openings are made with various sizes of cast-iron pipe, 1,500 tons being used in all. The openings requiring a span of 6 to 20 ft. are made through concrete culverts, while above a 20-ft. span plate-girder spans on concrete abutments are employed. The details of a standard 20 ft. concrete arch are shown in one of the accompanying illustrations, and a view of a completed 15 ft. arch is shown in another illustration. It may be noticed that the bench walls are not battered on the face, and also that there is a shoulder between the wing walls and the opening of the culvert. The entire absence of any floating debris which might lodge against this shoulder and congest the waterway was considered to justify the construction of the wing walls in this manner, thus avoiding any batter of the bench walls, and also any angles in the face of the wing walls. A few flat-top reinforced concrete box culverts, with spans of 10 and 15 ft., have been built where a considerable waterway was required under an embankment with limited head room.

The concrete in all the structures has been laid quite wet without facing. The crusher run of broken stone, with the dust and all pieces exceeding 2 in. in their greatest dimension screened out, has been used, with sand that is generally obtained locally. Three brands of cement, Universal, Red Ring and Wolverine, have been employed. These materials are mixed in the proportions of 1 of cement, 3 of sand and 5 of broken stone.

The Peoria & Eastern division runs nearly east and west through Danville, and the connection between it and the Indiana Harbor R. R. is made in a comparatively easy manner. The Cairo division is built at present only to a junction with the Wabash R. R. at Tilton, about 3 miles south of Danville, and the traffic from this division goes into Danville over the tracks of that road, the Peoria & Eastern division intersecting the Wabash at Danville Junction, 1½ miles east of Danville. A double-track extension to the Cairo division is being built from its junction with the Wabash to a junction with the Peoria & Eastern division one-quarter mile west of the point where the Indiana Harbor R. R. connects with that division in Danville.



Standard 15-ft. Concrete Arch Showing Vertical Bench Walls.

The extension is 3½ miles long and crosses the Salt Folk of the Vermilion River just west of its junction with the North Fork. The country is unusually precipitous, and in order to make the connection without exceeding the extablished maximum grade of 0.35 per cent., which is a southbound grade, it is estimated that approximately 500,000 cu. yd. of material will have to be handled in these 3½ miles. The connection between the two divisions will be near the North Fork of the Vermilion River, which stream is crossed by the Peoria & Eastern division on a fill 65 ft. high above the bottom of the stream, a pair of 50-ft. concrete arches, described in The Engineering Record Aug. 30, 1902, forming the waterway.

The tracks of the Cairo division will parallel those of the Peoria & Eastern division west from the junction between the two roads, across the fill over the arches, and then turn south, crossing the Salt Fork, a mile below. The fill over the arches is being raised several feet and widened to make room for the additional tracks. The material used in this work is obtained by making a cut of 130,000 cu. yd. on the Peoria & Eastern division, beginning about ½ mile west of the arches. This cut will eliminate a long helper grade and greatly improve the facilities for handling freight west out of Danville. It is being made by a 3-yd., 80-ton Osgood steam shovel working in connection with two 20-car trains of standard guage, 5 to 7-yd. dump cars and the fill is brought to grade under traffic on temporary tracks shifted as the work progresses. A cut, wide enough for 4 tracks, begins on the extension just beyond the point where it leaves the fill over the North Fork and will be carried south to the edge of the valley of the Salt Fork.

The valley of the Salt Fork is about 2,000 ft. wide with a maximum depth of nearly 100 ft. below the established grade line. The north side of the valley has a comparatively gradual slope from the south end of the four-track cut, but the south bank is practically vertical to a height of 130 ft., extending 30 ft. above the grade line. A fill containing 300,000 cu. yd. of material is being made across this valley and the stream will be carried through the fill in a 100 and two 80-ft. concrete arches which are being rapidly erected. A timber trestle, 2,000 ft. long, that is largely more than 60 ft. high and has a maximum height of 90 ft., has been built to make this fill. A view of the trestle when it was nearly completed is shown in an accompanying illustration. It is built of two stories of timber bents founded on piles driven to hard pan and the whole structure thoroughly cross-braced. The timbers are all 12x12-in. sticks, 30 ft. long, with 3x12-in. cross braces. A temporary track was laid from the Peoria & Eastern division and the 600,000 ft. board measure, of material required in the construction of the trestle delivered at the site. The piles were driven by a land driver, cross-braced and capped. After enough piles had been driven, work was commenced on the erection of the timber. The timbers were hoisted in place with a block and tackle on a gin-pole set up at the middle of the bent being erected and the timbers for the bent lashed to a cross arm on the gin-pole, when they were in position, until they could be drift-bolted together, cross-braced and sway-braced to the bent in the rear.

The north end of the fill will be made first, pending the completion of the concrete arches which are against the south bank, a reverse curve having been made in the trestle to clear the centering for the arches. The bulk of the material for the fill is to be obtained from cuts to the south, although about 70,000 cu. yd. can be procured from the surplus of the cut on the Peoria & Eastern and the four-track cut just north of the trestle. For 3,500 ft. from the south end of the trestle is a succession of gulches 30 to 60 ft. deep, and from 100 to 1,000 ft. long, with steep hills between them which rise 20 to 40 ft. above the grade line. Beyond this rough ground is a cut about a mile long, requiring the removal of upwards of 250,000 cu. yd., from which the majority of the material for the big fill is to be obtained.

A standard-gauge track is laid on the trestle, with gauntleted rails arranged so narrow-gauge trains can also be operated over it. The four-track cut is being made by grading machines working in connection with dump-wagons which discharge through a trap into narrow gauge cars on a track below that extends out over the trestle. As soon as a standard-gauge track can be laid through this cut trains will also bring material in from the cut on the Peoria & Eastern division.

The short, heavy fills just south of the trestle were brought to grade by grading machines, dump wagons and wheel scrapers, and enough of the cuts between them made so track may be laid from the trestle to the long cut to the south. A 60-ton Marion and a 65-ton Bucyrus steam shovel are at work in this cut and trains of standard gauge flat cars are in operation in connection between the shovels and the trestle. The material is unloaded from these cars when they are on the trestle with a center plow and a Lidgerwood rapid unloader in order to equalize the fill on each side of the trestle as nearly as possible.

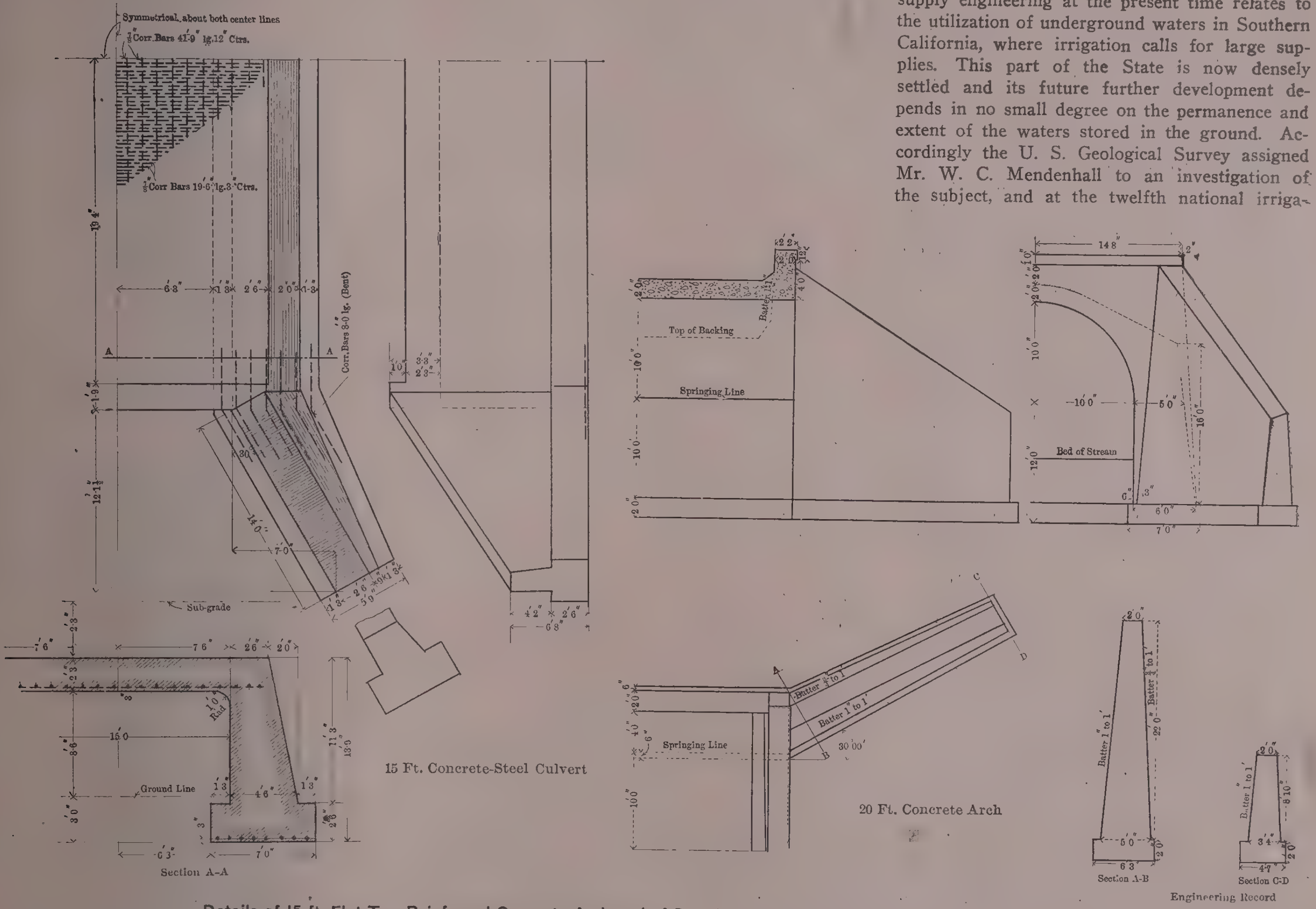
As soon as the concrete work is finished the trestle will be torn down south from the curve and erected again in line over the arches and the fill completed.

A highway, the tracks of an interurban electric railroad and those of the Wabash R. R. are crossed undergrade within a distance of 500 ft., near the middle of the long cut in which the two steam shovels are at work. The traffic on all these lines is very heavy and the work of making the cut beneath them without interfering with traffic is greatly complicated.

The Cairo division is to be largely reconstructed, the grades reduced to a maximum northbound grade of 0.3 per cent., a maximum soundbound of 0.5 per cent., and a maximum of 2 deg. of curvature established. Work on the extension is being carried on night and day, a large number of electric arc lamps having been installed, and every effort is being made to complete the work before the close of the season.

The extension of the Indiana Harbor R. R. was located by Mr. R. B. Seymour, chief engineer, and it is being built under his immediate direction. Mr. B. C. Rich is Mr. Seymour's principal assistant engineer. Mr. C. W. Hotchkiss is president of the Indiana Harbor R. R. The general contract for the north 15 miles is being executed by the Knickerbocker Ice Co., of Chicago. The general contract for the next 40 miles was awarded to Winston Bros. Co., of Minneapolis, Mr. J. E. Stevens, superintendent. The 54 miles from Kentland to Danville is being built by MacArthur Bros. Co., of Chicago, Mr. J. Duffy, superintendent. The concrete work is being done by the Bates & Rogers Construction Co., of Chicago; the Great Lakes Dredge & Dock Co., of Chicago, and Woods & Hamilton.

The betterment work on the Peoria & Eastern division and the extension of the Cairo division of the Cleveland, Cincinnati, Chicago & St. Louis R. R. are under the general supervision of Mr. W. M. Duane, superintendent of construction on that road. Mr. F. W. Smith, division engineer of the Cairo division, is in immediate charge of the work on his division. The MacArthur Bros. Co., of Chicago, Mr. George H. Penglase, superintendent, is carrying on the work of both divisions in the vicinity of Danville. The concrete arches over the Salt Fork of the Vermilion River are being built by the Bates & Rogers Construction Co., of Chicago, Mr. E. Stanley Holland, superintendent.



Details of 15-ft. Flat-Top Reinforced-Concrete Arch and of Standard 20-ft. Concrete Arch, Indiana Harbor R. R.

The Diminished Yield of Underground Waters in Southern California.

One of the most interesting problems of water-supply engineering at the present time relates to the utilization of underground waters in Southern California, where irrigation calls for large supplies. This part of the State is now densely settled and its future further development depends in no small degree on the permanence and extent of the waters stored in the ground. Accordingly the U. S. Geological Survey assigned Mr. W. C. Mendenhall to an investigation of the subject, and at the twelfth national irrigation congress he gave some interesting notes concerning the results of his work.

The greatest population and the highest cultural interests in Southern California are concentrated within a wide diversified valley that extends inland 80 miles from the Pacific Coast at Santa Monica, and is effectually screened from the Mohave and Colorado Deserts by the San Gabriel and San Bernardino Mountain Ranges. These high groups protect the land on their Pacific slope from the climatic extremes of the deserts, and at the same time wring from the ocean winds the moisture with which they are laden, and which in the form of perennial streams, makes possible the high state of cultivation that has given some of the adjacent agricultural lands values of from $500 to $2,000 per acre. Yet the rainfall is low—from 10 to 20 in. in the valleys—and this, and its concentration within a few months of the year, are conditions which demand irrigation to insure crops even of grain and hay, and make it imperative for the much more valuable citrus lands, walnut groves and gardens.

By 1880 the available flowing waters had been generally diverted and utilized, and the limit seemed to have been reached to the amount of land reclaimable from this important source, but the stimulus of the very high values reached by the California citrus lands, and the comparatively small acreage under cultivation as compared with that reclaimable if water were available, combined to induce a most thorough examination of all possible sources. After the appropriation of the normal stream flow, there remained two additional possibilities sufficiently inviting to enlist the attention of capital and skilled service. Because of the high gradients of the California river beds, and the steep slopes of the mountains where the greater part of the rainfall occurs, as well as because of the fact that a large part of the annual precipitation falls during heavy storms of moderate duration, there has always been a heavy loss of water through run-off during floods. If this could be saved by impounding reservoirs, a great gain would be effected. But the generally constricted character of the San Bernardino and San Gabriel mountain canyons has been unfavorable to the construction of reservoirs. Actually but two important projects have been completed; the Bear Valley dam, whose stored waters have added the flourishing Redlands colony to the reclaimed areas; and the Hemet dam, less favorably situated as regards rainfall, and less successful therefore in the matter of acreage redeemed. Another project, the Arrowhead, is under way after years of patient observation of rainfall and run-off, hence eventually there will be a further addition to the waters conserved in this way.

The second attractive possibility for the development of additional water lay in the development of the great underground reservoirs. The Gage canal system, completed in 1886, has depended from the first almost entirely upon underground waters, and its 7,500 acres of splendid citrus lands are an example of what may be done with them. Since this experiment the development of underground waters in Southern California has continued, until now there are nearly 3,000 artesian wells and about 1,600 pumping plants, representing a capital of about $3,500,000 and a combined production of at least 400 to 500 second feet continuous flow.

This development, although under way for thirty years, was given a great forward impulse by the series of dry years which began a decade ago. The previous ten years had abundant rainfall, well above the average, although this vital fact was not generally recognized by water users. As a consequence the acreage brought under cultivation during those years exceeded the amount which the ditches depending upon surface streams could serve when the drier period came on. The most important and valuable of California crops are perennial plants, citrus and deciduous fruits and walnuts which cannot be rapidly adjusted to fluctuations in the water supply. A grove which does not come into profitable bearing until five years after planting, represents by that time considerable capital. If the water fails it for a season, that capital is lost. Hence great energy has been displayed in the development of water as the surface supplies have dwindled under the influence of the drought. There are few important irrigating systems whose supply has not been augmented during the ten years past by the boring of wells whose flowing or pumped water is used to make up the deficiency in stream flow. And in addition much independent irrigation has been undertaken whose supply is well water entirely.

It has been fortunate indeed for Southern California that she has had large bodies of subterranean waters to draw upon. This fact has enabled her to come safely through so trying and generally fatal a combination of circumstances as a decade of heavy rainfall, and consequent exaggeration of her most fundamental asset, accompanying such a rapid industrial development as to constitute a boom of the first order.

The valley of Southern California is not a normal stream valley, carved by stream action and adjusted in width, depth and alignment to the volume and course of the stream. It owes its character entirely to other agencies, those agencies being crustal movements. This diversified low land may be best described as a series of deep, irregular crustal troughs, parallel to each other and to the Pacific shore line, plunging to the northwest and abutting in this direction against the granitic San Gabriel range. At the foot of this range the ridges separating the troughs are lowest, and a practically continuous valley extends from Santa Monica to San Bernardino. Farther south the separating ridges rise higher, and the valley is broken by mountain chains and groups. As these troughs and their separating ridges have formed by geologic processes, the previously existing rivers have maintained their way across them from the higher mountains where they rise, to the sea, and in maintaining these courses have cut canyons in the ridges and have filled the troughs with the sands, gravels and clays that are due to their erosive action. The result is a series of deep bedrock valleys filled with alluvium, across which the rivers flow. These conditions give rise to certain peculiarities in the habits of the rivers, which adapt them in a wonderful way to man's needs as an irrigationist.

The Santa Ana River is the most important of these Southern California streams, has the largest drainage basin, the longest course, and exhibits these beneficent peculiarities in the greatest perfection. It rises in the higher San Bernardino Mountains where rainfall is abundant, and has attained a volume of from 25 to 50 second-feet when it reaches the first of the filled geologic troughs at the mouth of its upper canyon. Here it promptly sinks in the coarse debris and percolates slowly below the surface, protected perfectly from evaporation and contamination until it reaches the lowest point in the rim of this depression. This rim forces it to the surface, and it flows across it as a living stream, the waters which escape diversion sinking again in the gravel filling of the second trough. After a short subterranean course it is forced out again by the impervious rock at Riverside Narrows, and continues to flow over the surface through the Santa Ana Mountains until beyond these it reaches the inner edge of the greatest of the troughs, the Coastal Plain, in which it sinks. Below Santa Ana it rises once more in a series of strong scattered springs and escapes to the sea.

This hide and seek habit is characteristic of the rivers of this valley, and is as ideal an adaptation to the needs of the arid land horticulturist as though definitely planned by man for his own benefit. The lower rims of the rock folds force the water to the surface at very convenient intervals for diversion, and meanwhile not only is the water in its underground passage saved from loss by evaporation, but the irregular spasmodic supply at the canyon mouths is converted into a uniform flow which is unaffected by individual storms, and responds but slowly to prolonged wet or dry periods. These basins are, therefore, not only storage reservoirs, but are most effective regulators as well, and go far to bring about that most important desideratum in irrigation practice, uniformity of supply. An additional important economic factor is introduced by the presence of artesian conditions along the lower margin of each of these storage basins.

The material with which the rock basins are filled is alluvium. At the lower margin of any particular basin, where the velocity of flow is least, the finest materials are laid down as clay sheets. These have the original slope of the stream bed and are limited in their extent upstream. In this direction they gradually become coarser until they are no longer impervious. The waters entering the valley at the canyon mouths and percolating seaward below the surface through the more porous strata are entrapped beneath these sloping clay blankets, where, under the weight of the waters behind them, they accumulate pressure. Then when the impervious clay cap above them is pierced they flow.

These cheap artesian waters are well distributed in Southern California, and have been important elements in its development. The original area of the lands under which they were found was about 375 square miles, but it has suffered a shrinkage of 33 per cent. during the last fifteen years and now measures only about 250 square miles.

Since these artesian basins are unlike the normal synclinal folds in porous rock which have come to be regarded as the type, so they have special characteristics which bear directly upon their usefulness. In the first place, being in wholly unconsolidated and generally coarse material, they have a high transmission capacity. So freely does the water flow through them that individual 10-in. wells have in a few cases yielded 6 or 8 second-feet of water. Such wells do not fail because the water supplied at the head of the alluvial fan cannot reach the boring, as has been the case in the Denver basin, for example. On the other hand, flowing so freely they draw down the supply at a very rapid rate, but can be restored if closed for a time, while a new supply is allowed to accumulate. The fact that the water-bearing strata lie approximately parallel to the surface, and that the highest are very near it, facilitates development to such an extent that ranchers in many instances have found it more economical to sink a well for each ten-acre lot than to distribute from a single central well. This condition encourages the multiplication of wells and the draughts upon the artesian supply.

It is these great rock basins, with their filling of saturated alluvial wash, which constitute the important underground reservoirs that have not only tided the region over a long period of low rainfall, but have actually made possible constant additions during the dry period to the reclaimed lands. These great natural reservoirs more than compensate for the lack of sites for effective artificial storage. Their actual capacity is to be expressed in cubic miles rather than in smaller units. The San Bernardino basin has been explored by the auger for over 1,000 ft., and is roughly estimated to attain a maximum depth of 3,000 or 4,000 ft. The alluvial filling about Pomona and Chino, and that east of Pasadena, above the Paso de Bartolo, is known to extend below sea level. The great Coastal Plain basin has been explored for 1,300 ft., and its depth, were it known, would probably be found to run well up into the thousands. With a surface area of 775 square miles and on the basis of 30 per cent. of voids, a very impressive but utterly valueless estimate might be made of the amount of water stored in it.

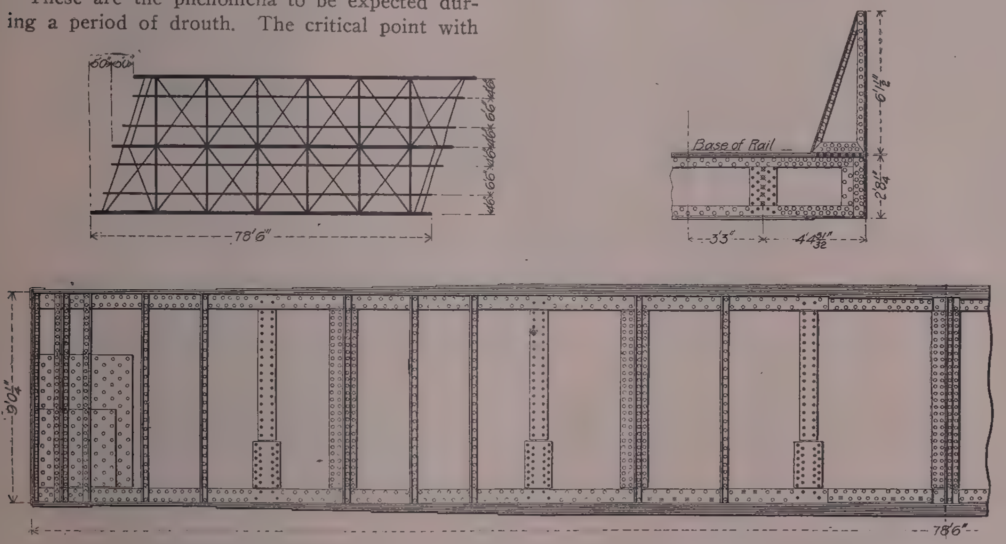
While the underground reservoirs have been of great value in carrying the irrigation interests over a period of moderate rainfall, their water level has been affected. Artesian areas have shrunken, and pressures in wells still flowing have decreased markedly. The thing which causes most surprise is that these shrinkages have not been more violent. The underground supplies have been attacked in front and rear. The summer and a part of the winter flow of the mountain streams is diverted at the canyon mouths and used for irrigation, where formerly all of it sank into the gravels and joined the underground supply. A few storage reservoirs have been built which hold a part of the winter flood waters that are now and always have been the chief source from which the ground waters are replenished. Thus not only has the supply been less during the past decade because of drouth, but it has been further curtailed because of diversion and storage. In addition to this indirect attack, the great number of artesian wells and pumping plants which have been put in have directly attacked the quantity of stored waters. It is estimated that of the 225,000 acres under irrigation in the valley of Southern California at present, two-thirds are dependent upon developed underground waters, about 400 to 500 second-feet of which are used while the surface streams supply but 200 or 250 second-feet. These relations are not fixed, there being a large acreage which is irrigated with surface water when this is abundant, but with well water when the streams are low. But the irrigation from developed water alone is increasing, while that from streams is at a standstill, or is shrinking, the flow of certain important streams which are due to rising ground waters having diminished during recent years.

These are the phenomena to be expected during a period of drouth. The critical point with the California irrigationist who is dependent upon underground waters is to determine how much of it is due to the dry period and how much to development. Obviously this is a difficult point. The amount of water returned to the gravels each year is scarcely capable of direct estimate, at least with the data now available. The greater part is contributed, of course, during the winter floods, but the measurements of these are difficult, and but few attempts have been made to estimate them.

Observations upon the fluctuations of the ground water level are perhaps of more value. A system of such observations has been begun by the Survey, but it will have to be continued for a considerable period before its results furnish a safe basis for conclusions. At present there are only two or three sets of observations within the valley which extend far enough back to be valuable. Fortunately, their evidence is harmonious. Mr. Mendenhall selected for discussion the profile of the water level in a well near Anaheim, on the inner edge of the Coastal Plain. Pumping plants are numerous in this vicinity and are being rapidly increased in number, so that the phenomena exhibited by this profile may be accepted as typical of those neighborhoods where most pumping is being done. For direct comparison with it a rainfall chart was prepared in which the departures from the average were shown for each year. From the time the observations began, in 1898, the declines were continuous and regular throughout the dry period, which was interrupted during the winter of 1900-1901 by an excess of rainfall. During this winter the water level rose 2 ft., but the gain was more than lost before the beginning of the next rainy season. The decline then continued, although irregularly, until the winter of 1902-1903, another year of excess in precipitation. Here again the profile rose, but again it was more than lost before the end of the year. Since that time the decline has been rapid.

The significant thing about this profile is that years in which the rainfall has exceeded the average have failed to stop the decline, although they have checked its rate. With present developments, then, the decline will continue, rapidly through years of deficiency, less rapidly through years of average rainfall, slowly through years of slight excess, and will cease only with an amount of excess greater than any had in a decade. This is a sufficiently serious showing to call for a halt in the development of underground waters. It does not necessarily mean loss of land now reclaimed, because it is recognized that the proportion of water available for the restoration of the underground supplies increases at a rapidly accelerating rate as the rainfall itself increases; that is, where a precipitation of 15 in. may add little to the underground supplies, with a fall of 20 in. nearly all of the last five may prove effective for this purpose, and a precipitation of 25 in., well distributed throughout a long wet winter, may restore the continuous declines of half a dozen years of deficiency.

But the evidence is quite sufficient to show that it is time to stop increasing indiscriminately the number of wells for reclamation of virgin lands. There is grave danger, in Mr. Mendenhall's opinion, that the splendid subterranean reservoirs which have carried communities through the past decade without distress, and have responded so fully to every demand made upon them, may be overestimated. Such supplies are everywhere peculiarly liable to overvaluation for several reasons. Among them is the fact that if the total quantity of stored water be estimated, the figures are so great that thoughtless users immediately conclude that such supplies are inexhaustible. Again, the fact that these great bodies of gravel are efficient regulators of the supply through rainfall, responding but slowly to periods of drouth or periods of excessive precipitation, and showing but slowly the effects of overuse, leads many to suppose them wholly independent of those controlling factors.



Bridge No. 6, Worcester Division, New York, New Haven & Hartford R. R.

Some Through Plate-Girder Bridges, New York, New Haven & Hartford R. R.

Bridge No. 19 over Wicketequock Cove, near Stonington, Conn., on the Stonington branch of the Shore Line Division of the New York, New Haven & Hartford R. R., illustrates the principal features of this company's regular standard, double-track two-girder through structures of moderate span. It is 71 ft. 4 in. long over all, has a clear opening of 64 ft. 2 in., and carries the rail at an elevation of 4 ft. 7½ in. above the lower flange of the girder. The web is made throughout with 96x⅝-in. plates, with four splices like the one shown. The 8x8x¾-in. flange angles are made in single full length pieces, and the maximum flange section has five 20x⅝-in. cover plates, the shortest 31 ft. long. The distances apart of the vertical stiffeners vary up to a maximum of 5 ft. 9. in. at the center of the girder, and where the floorbeams are connected there is a web stiffening angle on the outside only.

The floorbeams are 48 in. deep, with separate kneebraces field-riveted to their top flanges, and reaching to the top flanges of the girders. The stringers are 28 in. deep and besides being web-connected to the floorbeams are seated on bracket angles with reinforced horizontal flanges. The bottom flanges of the stringers are field-riveted to the lateral angles and the latter are field-riveted at the ends to horizontal connection plates engaging the webs of the floorbeams and of the main girders several inches clear of their lower flanges.

The shore ends of the stringers are in the same transverse lines as the ends of the main girders, and the extremities of their webs are reinforced by a pair of vertical web-stiffener angles 18 in. from the end which provide for the maximum shear over the flange bearing on a 9x¾x18-in. planed sole plate with a 12-in. bed plate having longitudinal guide ribs on both edges. The ends of the intermediate stringers are braced by a horizontal transverse strut like a light-lattice girder which is field-riveted to the vertical web-stiffener angles. The ends of the outside stringers are braced to the main girders by solid-web plate girder-like struts making an oblique angle with the axis of the bridge so as to engage the girder stiffeners at the points of connection with the bottom lateral angles, about 28 in. from the ends of the girders. The girders have cast steel shoes and pedestals similar to those described for deck girders on the same road, in The Engineering Record of Sept. 30, and their details, loading, materials, etc., correspond to those there described. This span weighs about 115 tons.

Bridge No. 6 of the East Providence branch of the Worcester division of the same railroad, is a single 78½-ft. span across the Providence division, and is characteristic of standard construction for a three-girder, double-track skew through plate girder span. The girders are 15½ ft. apart, 9 ft. deep and are divided into five 11 ft. 8 in. intermediate panels by the 32-in. floorbeams. The web of the center girder is of a uniform thickness of 9/16-in. and is spliced in every panel with double cover plates and four vertical rows of rivets. At each lower corner it is reinforced by four ⅜-in. plates riveted on over the end bearings to provide for the maximum shear. At each splice and at one or two points between the splices in each panel are a pair of vertical 6x3½-in. angles and fillers.

The maximum flange section consists of two unspliced 8x8x¾-in. angles and one full length and one 62 ft. 8-in cover plate each 21 in. wide and ⅝-in. thick, and four 21x½-in. cover plates. The ⅝-in. plates are each made in two pieces with their joints arranged so that they are spliced by the projecting ends of the ½-in. plates above them.

The 8x8-in. angles have joints staggered in the two middle panels on opposite sides of the web, but opposite each other in the upper and lower flanges. The angles are cut in lengths of 36 ft. 6 in. and 42 ft. 0 in., and their joints are spliced with pairs of sheared 8x8x¾-in. angles about 4 ft. 9 in. long. The outside girders are substantially like the center girder except that the web is only 7/16-in. thick, and has no reinforcement plates at the ends, and the maximum flange section has only three 21x½-in. cover plates.

The floorbeams and their deep kneebraces are riveted to the girder webs with fillers which space their connection angles out to the faces of the vertical legs of the flange angles. Each panel between floorbeams is X-braced by single 3½x3½ or 4x4-in. angles with their vertical flanges down, and the horizontal flanges riveted to the stringer flanges at intersections, and to connection plates engaging the bottom flanges of the girders and the floorbeams. Where the X-brace angles intersect, one of them is continuous and the other is cut to clear it and spliced with a plate or with a plate and an angle. In the end panels care is taken to develop the full strength of the angles in the connection by the use of short connection angles riveted to the vertical flanges and to the connection plates. The braces at the shore ends of the stringers are like those illustrated for bridge No. 19. The bearings are modified from those already described in that the transverse webs of the shoe and pedestal are made much thinner and have a semi-cylindrical extension on the upper edge to receive the pin. The complete span weighs 160 tons.

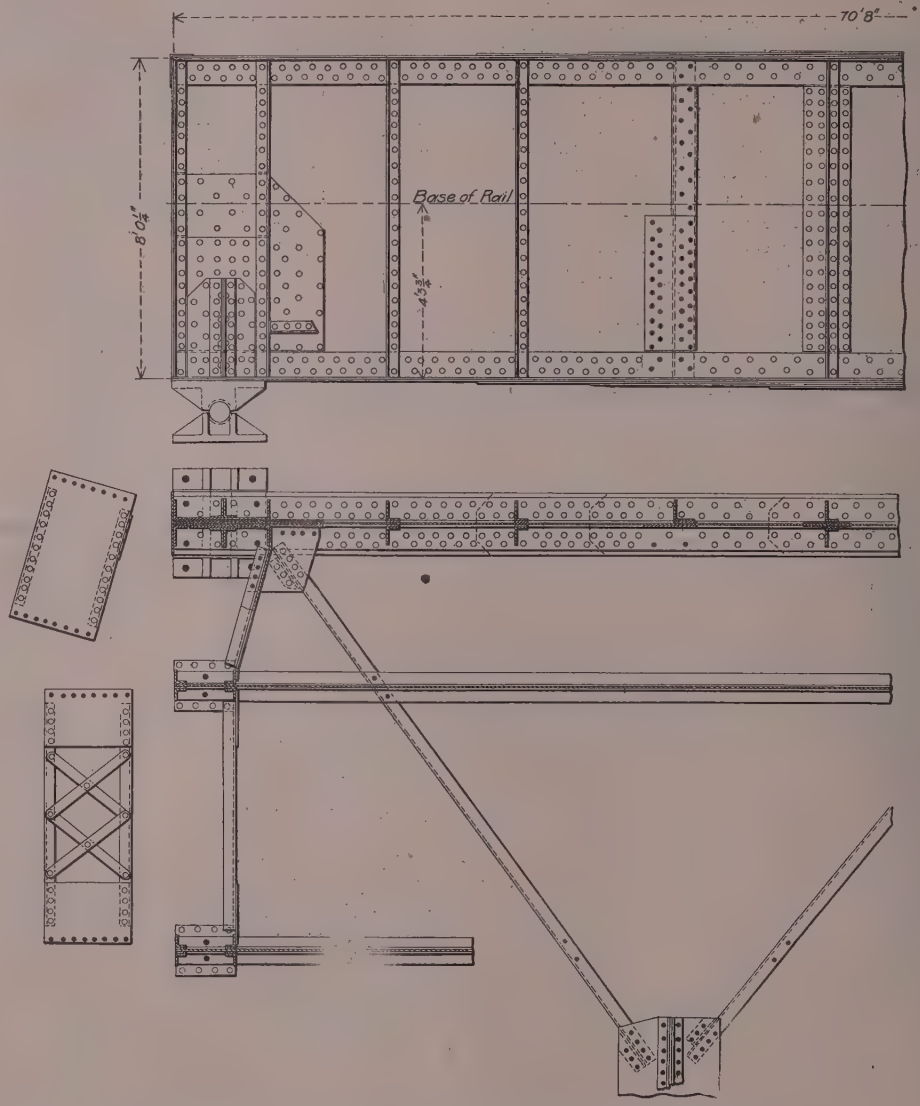
Bridge No. 1,057 at Ashley Falls, Mass., on the Berkshire division, is an example of standard construction of a regular long span, single track, through plate girder bridge. It has a clear span of 99 ft. 4 in., and the girders are about 9 ft. deep over all, and 16 ft. apart on centers. The web has a uniform thickness of 7/16-in., and is made in lengths of about 12 ft. 2 in. spliced for both shearing and bending moment stresses. The T-shape flanges are alike, top and bottom, and are made with 8x8-in. angles, side plates and cover plates with splices arranged as shown in the general plan and elevation.

The top flange angles do not extend quite to the ends of the girders, but are cut to clear the rounded upper corners of the girders. Their ends are cut square and abut against the ends of the end vertical web-stiffener angles of the same size which, being much shorter, are very much more easily bent to fit the curved corners, and are spliced to the flange angles by the cover plate, and by a slightly curved short cover angle on each side of the web. The end panel of the web plate is reinforced by a ⅜-in. plate riveted to each side and by four half height vertical angles over the center of the bearing on the shoe. The floorbeams vary from those already described, in that the web is made in three pieces, the two end sections projecting beyond the top flanges of the floorbeam to the tops of the girders, and making a kneebrace integral with the beam, thus affording a very rigid transverse bracing and abundant connection for the floorbeam reaction.

The end bearings of the girders are on cast-steel shoes 102 ft. 8 in. apart on centers, which, like their corresponding pedestals, each have one transverse and three longitudinal webs, all 2 in. thick. The transverse web is integral with a semi-cylindrical socket which gives continuous bearing to the hinge pin and reduces the stresses on it to simple compression. The edges of the bearing are beveled to give a minimum clearance of ½-in. between shoe and pedestal, and the bearings are recessed ½-in. at each end to engage the collars turned on the ends of the pin to lock it in place instead of the center collar used in some other cases.

The segmental rollers at the expansion end of the bridge have no guide ribs, but their ends are finished to fit accurately against guide ribs planed on the edges of the pedestal and bed plate surfaces. The bed plate is of cast steel 2 in. thick, with 5x3½-in. angles bolted on all sides to enclose the rollers and protect them from dust, etc. At the fixed end of the span the pedestals are seated directly on the masonry which is built up about 8 in. higher than at the other end so as to allow for the bed plate and rollers. All rivets are ⅞-in. diameter, with a minimum staggered pitch of 2 in. The span weighs about 145 tons.

Bridge No. 100 of the New York division forms part of the approach to the four-track Scherzer rolling lift bridge at Bridgeport, Conn., and has some special features differing from the usual construction for independent bridges. It has two spans, each with four girders 87 ft. 10½ in. long over all. These girders are arranged in pairs, each pair forming an independent double-track span. The girders are 15 in. and 29 ft. 3 in. from the axis of the bridge, thus spacing the center lines only 30 in. apart, c.c. The web plates are 120 in. deep and from ½-in. thick and 14 ft. 4¾ in. long in the center panels to ⅝-in. thick and 15 ft. 1 in. long in the end panels where they are reinforced by side plates to a maximum thickness of 3¼ in. and farther stiffened by half length vertical angles interpolated between the regular web stiffener angles. The web splices are made at the panel points where the floorbeams are connected and each has 140 rivets in six vertical rows through two 21x½-in. plates.

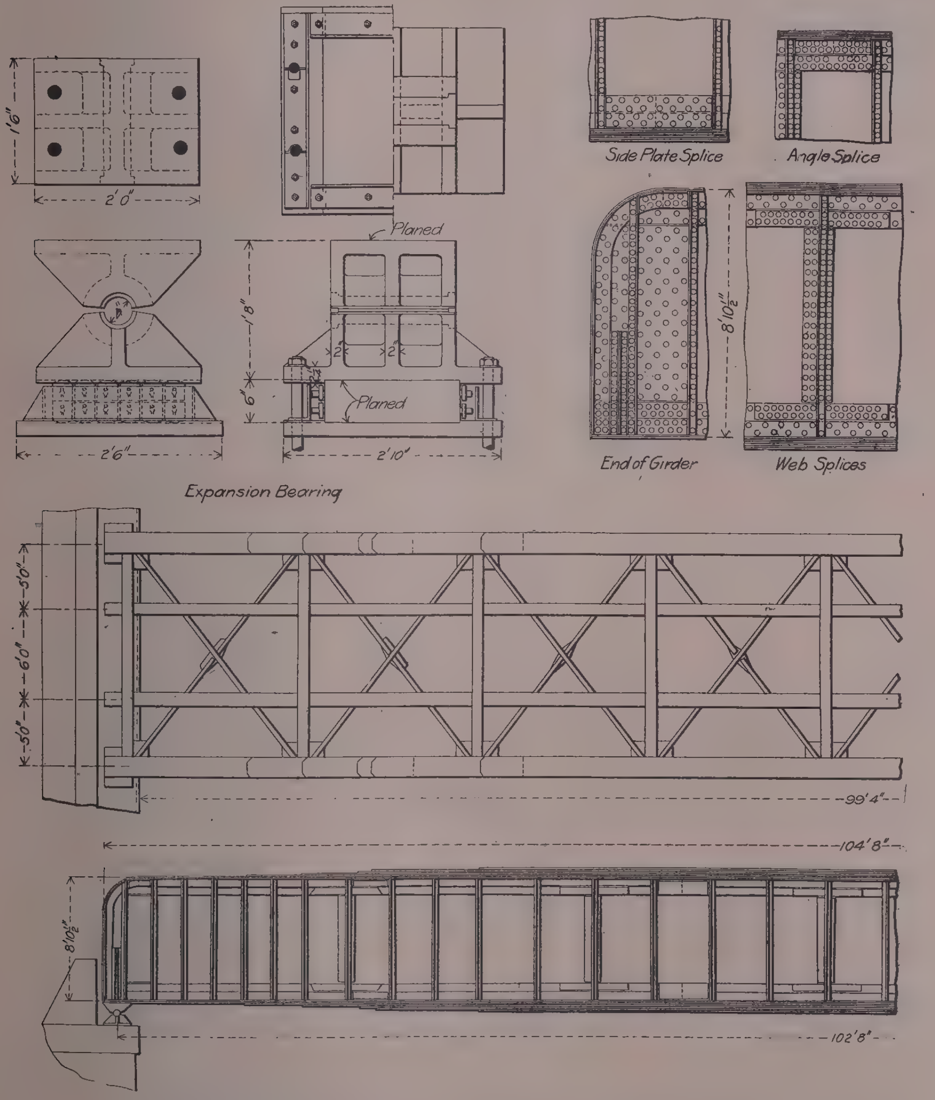


Bridge No. 9, Shore Line Division, New York, New Haven & Hartford R. R.

The T-shape flanges are unlike top and bottom, and at the top are made with two 8x8x⅞-in. angles and seven 18-in. cover plates without side plates. The first cover plate only is full length, but at the center of the girder they aggregate 4 7/16 in. in thickness, all but one of them being ⅝-in. thick. Each flange angle is made with one piece, 36 ft. 9 in. long, and one piece, 51 ft. 1½ in. long, with joints staggered on opposite sides of the web, but opposite each other in the top and bottom flanges, and spliced with pairs of 8 x 8 x ¾-in. cover angles one panel long, sheared to 7⅛x7⅛-in. The bottom flange cover plates are 20 in. wide, the first one is full length, in three pieces, spliced by the projecting ends of the outer plates. Three of the seven cover plates are ⅝-in. thick and the remainder are 9/16-in. thick.

The girders have standard hinge bearings made with 6-in. pins engaging half holes in cast-steel shoes and pedestals 85 ft. 3¾ in. apart on centers. A 21x¾-in. planed bearing plate about 2½ ft. long, called a "Wear" plate, is riveted to the bottom flange to receive the top of the shoe casting, and has four holes for 1¼-in. turned bolts. At the fixed ends the pedestals are seated on the masonry, but at the expansion ends, which are adjacent in both spans, they rest on nests of nine 6-in. segmental rollers seated on 1½-in. rolled bed plates 6½ ft. long, which extend across the top of the pier and receive the rollers of both adjacent spans.

The floorbeams are 27 ft. 9⅝ in. long over all, and have webs made of single 54x⅝-in. plates reinforced at each end with two 42x⅜-in. plates about 5½ ft. long. The top flanges are made with a pair of 6x6x¾-in. angles and one full length and two shorter 13x⅝-in. cover plates. The bottom flanges are made with two 6x6x¾-in. angles and one full length 15x⅝-in., one 15x⅝-in., and one 15x9/16-in. cover plates. The girder connection at each end is made with fifty 1in. rivets through the end vertical angles and with a solid-web kneebrace over 5 ft. high, field-riveted to the top flange of the floorbeam. The stringers are made with a 32x7/16-in. web plate and have two 6x6x½-in. angles in each flange. Each stringer-floorbeam connection has twenty-two rivets, besides which the lower flanges of the stringers are seated on shelf angles with their horizontal flanges reinforced by pairs of vertical distribution angles shop-riveted to the floorbeam web. Horizontal connection plates are riveted to the webs of the girders and floorbeams in the planes of the lower flanges of the stringers and receive the single X-brace angles which form the lateral system. Each girder weighs about 48 tons, and one double-track span weighs about 675 tons.



Bridge No. 1057, Berkshire Division, New York, New Haven & Hartford R. R.

All of the bridges here described were designed and built under the direction of the engineering department of the New York, New Haven & Hartford Railroad Co., Mr. C. M. Ingersoll, chief engineer, and Mr. W. H. Morse, engineer of bridges.

Cement Block Machines are made by 46 companies, five of which have supplied equipment to 1,422 different persons or firms, these equipments ranging from one to six machines each. The block industry is growing everywhere, but most vigorously in the wheat-belt States.

The Mechanical Filters at Youngstown.

A mechanical filter plant with a normal capacity of 10,000,000 gal. per 24 hours has been built at Youngstown, Ohio, to treat the water of the Mahoning River which was formerly pumped under direct pressure into the mains of the distribution system without any attempt at purification. The Mahoning River has a watershed of 960 sq. miles above the pumping station of the water works in Youngstown, and is subject to sudden and considerable variation in flow, with corresponding variation in the character of the water. The sewage of several towns above Youngstown which is discharged into the river, together with the drainage from a number of large steel mills in Youngstown above the pumping station, rendered the river unsatisfactory as a source of supply unless the water from it was filtered. In attempting to secure a more satisfactory supply, several projects were first considered for developing reservoir sites on creeks in the vicinity, which are tributaries of the river, and bringing the water by gravity from these reservoirs to the pumping station. The adoption of any of these sources, however, would have required the erection of a filter plant to insure a sanitary supply, so it was decided to adhere to the river as a source of supply and build a filter plant near the old pumping station; then, if it eventually became necessary, develop a supply on one of the creeks.

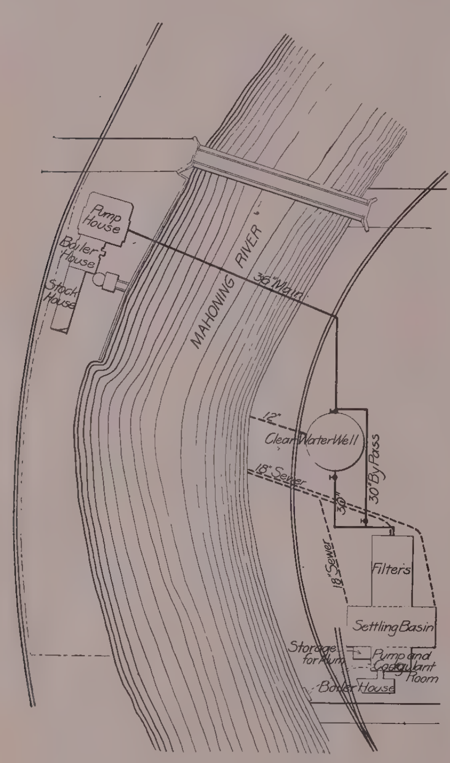
The present pumping station is on the north bank of the river in a very closely built up section, where there is little room to expand and no feasible site for a filter plant. A tract of vacant ground of several acres, bordering on the south bank of the river and immediately across from the pumping station, was acquired and the filter plant erected on it near the river and about 500 ft. upstream from the station. The filter plant embraces an intake in the river, a main filter building and a clear water well, arranged as shown in the accompanying plan.

The intake consists of a rock-filled timber crib extending 20 ft. into the river from a heavy concrete wall built in the river bank over the end of a 4-ft. brick conduit leading to a pump well in the main filter building. Five 12-ft. lengths of 20-in. pipe, three in a row at the bottom and two in a second row above them, are placed in this crib below the low-water line, with a space between the inner end of the pipes and the opening into the conduit in the concrete wall. Permanent pipe nozzles, connected with a 6-in. main under the regular pressure on the distribution system of 90 lb., are placed in the shore end of these pipes to facilitate flushing them. A recess in the river face of the concrete wall is fitted at each end with vertical channels in which copper screens are operated. The 4-ft. brick conduit is divided at the middle by a horizontal timber partition, and a blow-out attached to a main under distribution pressure is placed above and below this partition near the inner end of the conduit in order that the unusually heavy sediment with which the river is frequently charged may be flushed out readily.

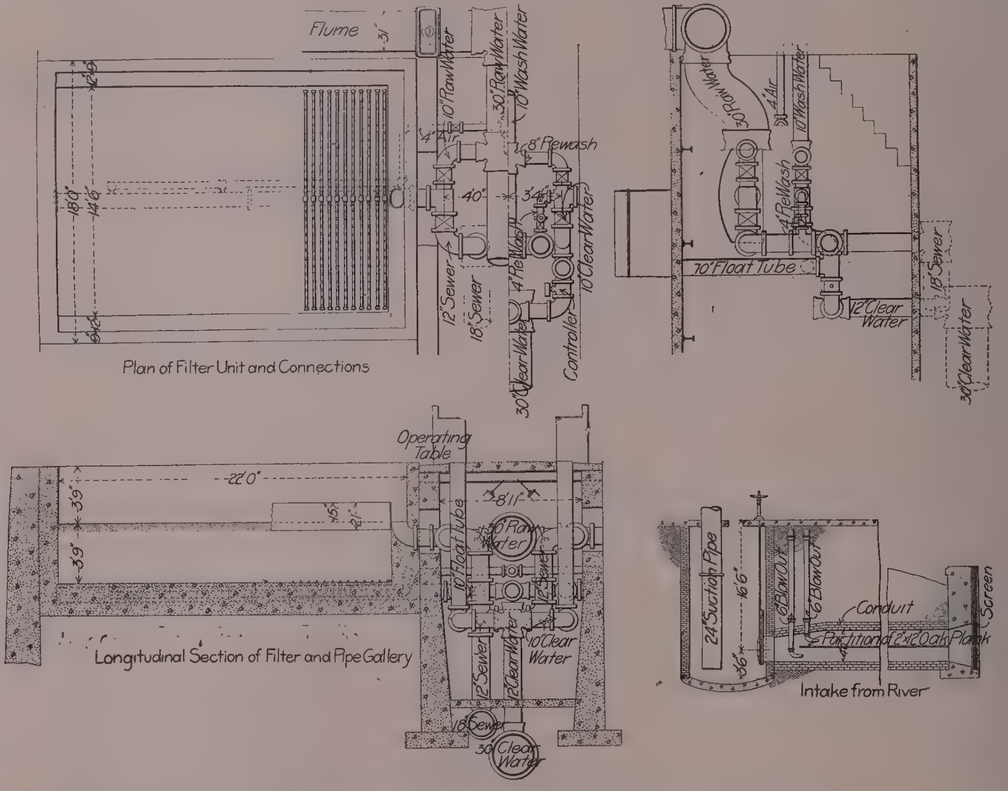
The main filter building is a cross-shaped, one-story brick structure, 139 ft. 6 in. by 211 ft. 6 in. in plan in its greatest dimensions, with a slate-covered, steel-truss roof, and with its sidewalls resting on heavy concrete walls which extend 6 ft. above the ground line. The portion of the building forming the upper part of the stem of the cross contains the pump and coagulant room, with two large laboratories on a second floor over part of the room occupied by the pumps. The remainder of the building forming the arm and lower part of the stem of the cross is one large room in which two sedimentation basins and twelve filter tanks are placed. The sedimentation basins are in the arm of the cross, which is 135 ft. 10 in. by 58 ft. 10 in. in plan, and is divided transversely at the middle by a concrete wall 9 ft. wide at the top. The twelve filter tanks are in the lower part of the stem of the cross, in two rows of six each, one row on each side of a longitudinal pipe gallery along the center line of the building. The clear-water well is about 150 ft. from the front end of the building, at the lower end of the stem of the cross, and is connected by a 36-in. main to the pumping station on the opposite bank of the river.

The water flows by gravity through the brick conduit from the intake to a brick pump well, 10 ft. in diameter and 20 ft. deep, under the floor of the engine pit in the pump and coagulant room. Two 10,000,000-gal., low-service, centrifugal pumps built by the William Tod Co., of Youngstown, elevate the water from this well and discharge it into a 30-in. main leading to the sedimentation basins. These pumps are direct-connected to vertical compound Reeves engines and are arranged in duplicate, one unit being capable of supplying the required amount of water. The 30-in. main leading to the sedimentation basins connects with an inlet to each basin at the inner corner next to the pump and coagulant room. Each of these inlets is 36x48 in, horizontal, wooden trough, 20 ft. long, which rests on iron brackets built into the concrete sidewall of the basin about half way up from the bottom. Longitudinal spaces are left between the planks in the sides and bottom of the trough to distribute the flow of the incoming water, the flow being controlled by a 24-in. gate valve on the branch connection with the 30-in. main from the low-service pumps.

Each sedimentation basin is partially divided by vertical baffles, as shown in the accompanying plan of the filter building, to insure a complete utilization of the entire 600,000 gal. of capacity of the basin. A longitudinal concrete baffle extends two-thirds the length of the basin from the inner end, with a transverse wooden baffle at the end of it and intermediate transverse wooden baffles on each side of it. The discharge from each basin is over a weir, 21.5 ft. long, formed by a ¼-in. steel plate fastened to the concrete wall of the basin by bolts through slots in the plate, which render its height adjustable. These weirs are in the corners of the basins next to the filters, and the water discharges over them into 30x30-in. flumes built in the tops of the dividing walls between the basins and the filters. Each flume is connected by a 30-in. branch with a 30-in. main, which extends the length of the pipe gallery and conveys the coagulated water to the filters. The flow through each of these connections is controlled by a hand-operated gate valve which has a standard on top the dividing wall between the basins. A 12-in. washout in the corner opposite the inlet in each basin is connected with a sewer leading to the river and permits the sediment arrested in the basin to be flushed out, while a 12-in. overflow in the same corner is connected to the sewer and prevents the water from going over the walls of the basin.



Location of Filter Plant.



Plan of Filter Unit and Connections

Longitudinal Section of Filter and Pipe Gallery

Intake from River

River Intake and Details of Piping Connections for a Filter.

The pipe gallery between the filters is 9 ft. in width and 14 ft. deep, giving sufficient room for all the pipes and connections of the filter tanks without crowding them. The gallery is covered by a reinforced concrete floor supported by 8-in. I-beams, on 36-in. centers, with their ends imbedded in the sidewalls of the gallery. This floor is at the same level as the tops of the walls of the filter tanks and connects with a walk on top the dividing wall between the sedimentation basins, the operation of the filters being carried on from it. The 30-in. main from the sedimentation basins is suspended from the I-beams which support the operating floor and is cross-connected to each filter by a 12-in. branch.

The filter tanks are each 16.5 x 22 ft. in plan at the top and 7.5 ft. deep to the top of their concrete floors. They are built entirely of concrete and the concrete walls of each tank are separate from those of the adjacent tanks and from the adjoining portions of the wall of the pipe gallery and of the building. The brick side walls of the building rest on the concrete walls of the pump and coagulant room and on the side walls of the sedimentation basins, which are deep and heavy in both cases. Around the filter tanks the concrete walls on which the brick building walls rest were built separate from the walls of the tanks in order to avoid as much as possible any liability of the concrete in the filter tanks being cracked by the settlement of the building and at the same time to reduce the depth of the filter walls.

The tanks are the same size in plan from the top to a depth of 3 ft. 9 in. where a 12-in. offset is made in the wall on the end next to the pipe gallery and in those on both sides, the size of the tanks being thus reduced from this point to the bottom. A ¼-in. steel plate, 21 in. wide, is bolted vertically on the outer edge of this offset so as to form a gutter 15 in. high and 12 in. wide on one end and both sides of the tank. The 10-in. branch of the 30-in. raw-water main from the sedimentation basins connects with a 10 x 14-in. horizontal elliptical opening in the bottom of the trough at the middle of the end of the tank. The raw-water enters through this opening and is distributed over the bed by the trough, the top of the steel plate being level enough to form weirs.

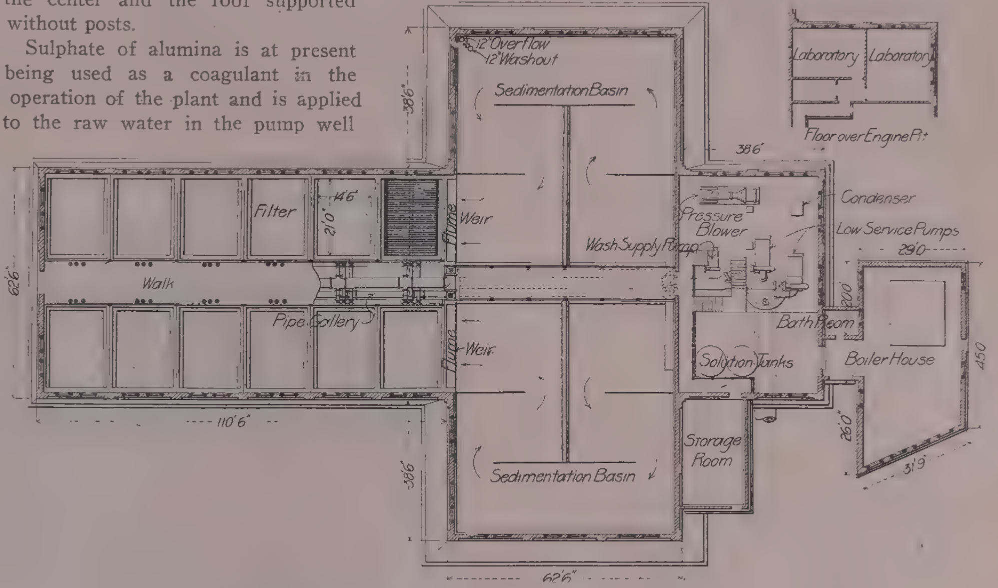
The filtering material is made up of 9 in. of gravel at the bottom, with 36 in. of sand above it. The main effluent manifold is a standard-weight 10-in. cast-iron pipe laid longitudinally the length of the bed at the center and imbedded in the concrete floor. Transverse 1½-in. wrought-iron collector pipes on 6-in. centers are screwed into this manifold and are also imbedded in the concrete of the floor. Into these transverse collector pipes are screwed brass strainers made according to the Deutsch patents by the Federal Filtration System, of New York. The arrangement of the strainers is such that they are on 6-in. centers in each direction, making 1,176 strainers in each tank. The 10-in. effluent manifold is continued outside the tanks in a 10-in. clear water pipe, the two 10-in. pipes of each opposite pair of tanks joining in a 12-in. vertical connection with a 30-in. main laid beneath the floor of the pipe gallery. The filtered water flows through the 30-in. main to the clear-water well and thence from the clear-water well through the 36-in. main leading to the pumping station, a by-pass being provided so the water may be sent directly from the filters to the pumping station.

The filter beds are washed by a reverse flow of filtered water, assisted by agitation of the sand bed with compressed air. The wash water is supplied by a 4,000,000-gal. centrifugal pump built by the Wm. Tod Co., of Youngstown, and driven by a vertical Reeves engine. The suction of this pump is connected with the 30-in. filtered water main, the suction and discharge pipes being carried to and from the pump through a 3 x 5 ft. tunnel, built longitudinally in the dividing wall between the sedimentation basins. The wash water enters each filter tank through an 8-in. connection between the 10-in. wash-water supply main and the 10-in. effluent manifold of the tank, and is applied directly through the same system of pipes and strainers that collect and carry the filtered water from the sand bed. The air is supplied by a 14 x 36 x 18-in. Laidlaw-Dunn-Gordon straight-line compressor and is under approximately 4 lb. pressure at the tanks. The 4-in. air main from the compressor is carried through the tunnel in the dividing wall between the sedimentation basins and is connected by a 4-in. branch to each tank. The air connections in the tanks are imbedded in the floors of the tanks below the transverse collector pipes and are connected at three points with the main effluent manifold. The air is thus applied through the strainers without any separate system of piping. The plant has been in actual operation only a few weeks, but in that time unusually good distribution of the air and wash water has been obtained through the single system of piping and no difficulty has been experienced from air remaining in the collector system.

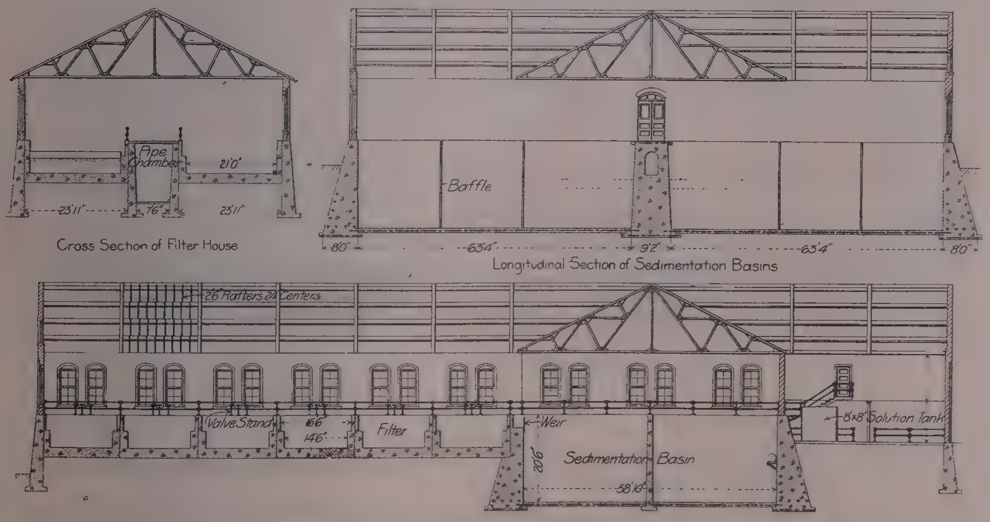
When a bed is to be washed a valve on the raw-water supply pipe is shut and after the water has been drawn down a few inches below the top of the trough, a valve on the effluent pipe is closed and the water over the bed inside the trough held at that level. The water in the trough is drawn off through the inlet opening by opening a valve on a 12-in. connection with the sewer, the sewer outlet and raw-water inlet connections being made through the same pipe as shown in one of the accompanying drawings. The air is then turned on and after the bed has been thoroughly agitated the air is shut off and the wash water turned on through the effluent manifold. The wash water passes through the collecting system, then up through the filtering material and over the weir of the trough into the sewer. When the washing of a bed has been finished the wash water is shut off and the sewer connection with the inlet closed after the dirty water in the trough has been drawn out. Raw water is then admitted again and the first water passing through the sand bed is wasted until the effluent is clear through a 4-in. by-pass connecting the clear water effluent with the sewer, and then the tank is thrown in service again.

The valves on all the pipe connections of each filter are operated hydraulically and are controlled from the platform over the pipe gallery. A small marble-top table, with hardwood panels at the front and ends and open at the back, is provided for each tank. A brass operating handle, having the name of the pipe controlled by it cast in a plate attached directly under it to the table, is provided for each valve and the position of the valve is indicated by a pointer on a brass dial fastened to vertical panel at the back of the table, each dial being in line with its corresponding operating handle. The pointers on the dial are operated by wires on wheels attached back of the panel to the axis of the pointers. These wires are attached to the valve stems and the perimeter of each wheel is one-third the stroke of the valve stem with which the wire on it is connected, the length of the wire being arranged so the pointer always indicates the exact position of the valve. A spigot attached to the clear-water effluent pipe of each tank is provided on its operating table. A loss-of-head gauge is also to be placed on each table. The pointers on each of these gauges will be actuated by a float in a vertical 10-in. float tube connected with the 10-in. clear-water outlet of the tank with which it is connected, the pointer being set at zero when the sand bed is clean.

The controllers are butterfly valves set in the effluent pipes just beyond the vertical float pipe for the loss of head gauge and are operated through a system of levers by a float in that pipe.



Plan of the Interior of the Filter Building and Boiler House



Cross Section of Filter House

Longitudinal Section of Sedimentation Basins

Sections of Filter Building Showing Arrangement of Filter Tanks and Sedimentation Basins.

The specifications require these controllers to permit the passage of water at a rate of not more than 850,000 gal. per day from each filter when the filter is clean and under the full head. It must also permit the passage of the full amount of water when the filter is dirty and the head reduced nearly to nothing. The discharge is through closed pipes to the clear water well, and must allow the water to pass when the water in that well is higher than the controller.

The clear water well is 84 ft. in diameter and 20-ft. deep, with a capacity of 665,000 gal. It is built entirely of concrete, with a conical slate-covered steel-truss roof, the trusses being joined by a special connection to a 16-in. steel pipe at the center and the roof supported without posts.

Sulphate of alumina is at present being used as a coagulant in the operation of the plant and is applied to the raw water in the pump well of the low-service pumps. The chemical solution is made in two 8 x 8-ft. circular wooden tanks in the pump and coagulant room. These tanks are fitted near the bottom with perforated circular brass pipes through which compressed air is supplied to agitate the solution while it is being prepared. The solution is made in one tank at a time and while a supply is being drawn from one tank additional solution is made in the other. The solution flows by gravity from the tanks to a regulating box just above the pump well, the level of the liquid in this box being kept at a constant height by a float actuating a valve on the inlet pipe. The outlet from this box is through an annular slit, 1 in. wide, made in half of a circular plate fixed in the bottom of the box. Resting on this plate is another half-circular plate which may be revolved on an axis. This axis extends up above the surface of the liquid and carries an indicating device showing the amount the slot is open, the rate of discharge of the orifice having previously been determined.

The combined capacity of the two sedimentation basins is 1,200,000 gal., which is approximately one-eighth the capacity of the plant and provides nearly 3 hr. sedimentation for the coagulated water when both tanks are in service and the plant is operating at the normal rate. Each filter bed has an area of 304 sq. ft. and is designed to filter 833,000 gal. in 24 hr. Wash water is intended to be applied at the rate of 1 cu. ft. per square foot of filter area per minute. All devices connected with the beds are designed, however, to operate successfully at a rate 25 per cent. above or below the above rates.

The site is well adapted to the location of a filter plant and no particular difficulty was experienced in the construction work. The concrete in the walls and floors of the clear water well, sedimentation basins and of the concrete footing walls of the building was made in the proportions of 1 part cement, 3 parts sand and 5 parts broken stone that would pass a 2½-in. ring. The concrete in the filter tanks was mixed in the proportions of 1 part cement, 2 parts sand and 4 parts broken stone. Briar Hill slag cement was used in the greater part of the work, but Atlas Portland cement was used in the finishing work. Sand obtained locally and broken limestone were employed. All concrete was mixed wet in a Smith mixer and the stone spaded back from the forms as the concrete was laid to make as smooth a surface as possible.

The floors of the sedimentation basin and the clear water well are reinforced with expanded metal. A 5-in. layer of concrete was laid first over the whole floor and the reinforcement placed over that, then the remaining 7 in. of concrete in the floor was laid. The footing walls of the building and the walls of the sedimentation basins were carried up in 2½-ft. courses extending entirely around the building. The forms for this portion of the work were built up in sections about 3 ft. high and 16 ft. long. Each section consisted of three 2 x 12-in. plank nailed to cross pieces. When concrete had been laid nearly to the top of them and entirely around the building, the plank sections were raised by block and tackle to make forms for the next course. The vertical posts to which the sections were nailed could thus be kept in line easily and at the same time a large saving was made in lumber for forms. The concrete in each filter tank was laid in a continuous operation to avoid any joints in it due to difference in mixture or other causes.

The brick work of the building was laid in cement mortar and the inside walls of the pump and coagulant room and those of the room in which the filter tanks and sedimentation tanks are placed were plastered and painted white. The exposed surface of all the concrete in the building was plastered with cement mortar floated to a smooth finish. The operating tables for the filters and four standards on the valves of the sedimentation basins are the only operating apparatus visible in the filter room, giving it, together with the generally neat interior finish, an unusually attractive appearance.

Quicksand was encountered in making the excavation for the clear-water well and some difficulty was experienced in completing the excavation and in laying the concrete. The 36-in. main leading from the clear-water well to the pumping station is double strength cast-iron pipe with lead joints. The river crossing was laid 100 ft. from each end in cofferdams, then the end of the pipe in one cofferdam blanked, the end of that cofferdam torn out and the pipe floated. Lengths of pipe were next added at the land end of this section and the joints made between the lengths. As the joints were finished the section was drawn toward the stream end of the cofferdam on the opposite side of the river by a hoisting engine on that bank, the pipe being anchored in the water between operations.

The contract for the intake, boiler house, filter building, clear-water well and all filtering appliances, including connections between filter building and clear water well, was awarded to Messrs. Thomas Lightbody & Son, of Youngstown, for $110,000. The machinery equipment was furnished by the William Tod Co., of Youngstown, for $9,400. The boiler house contains two 125-h.p. water-tube boilers, built by the Sterling Boiler Co., at a cost of $4,200. The total cost of the plant, exclusive of the heating and lighting and the 36-in. river crossing was $123,000. The valves in the entire plant were made by Mr. C. W. Thomas, of Detroit, Mich. The cast-iron pipe was furnished by the Massillon Iron & Steel Co.

The plant, as constructed, was designed by Mr. F. M. Lillie, city engineer of Youngstown, assisted by Messrs. H. M. Reel and S. A. King, assistant engineers, and with the advice of Mr. W. S. Hamilton, superintendent of the water works. Mr. Geo. W. Fuller, of New York, was the consulting engineer. The plant was built under the direction of the Board of Public Service, Mr. David Heintselman, Pres., with Messrs. Hogan and Vetter as the other members. The committee of the city council which had much to do with the adoption of the plans for the plant and their execution consisted of Messrs. Middleton, Truesdale and Parrock.

Interior of Filter Building, with Sedimentation Basins in the Rear, Youngstown, O.

Highway Location in Iowa has been largely along land section lines, and the road system has accordingly been developed without any regard to the engineering principles of economy and efficiency. In the "Manual" of the Iowa Highway Commission, it is stated that oftentimes the total cost of entirely relocating a road will be less than trying to make even a faint start along the section line. In a case illustrated, the section-line road which climbs one steep hill after another is parallel to a valley where the road could have avoided all the hills. At one place on this road a new right of way was purchased around a hill and an almost level road made at a cost of only $70; on a nearby hill, the cost of the necessary grading was about $1,000. A railroad running out from the same town followed the valley almost parallel to the wagon road, showing very clearly where a competent engineer would plan the highway.

Water Softening at Oberlin.

The water supply of Oberlin, O., is obtained from a surface source in an agricultural district and has a normally low bacterial content, but it is so heavily charged with carbonates and sulphates of lime and magnesia as to be entirely unsatisfactory as a municipal supply. A water-softening process has been adopted to remove these substances, which is based first on the fact that carbonates are only partially soluble except in the presence of free CO_2, and also that the sulphate of magnesia can be decomposed by adding sodium carbonate and calcium hydrate to the raw water, into insoluble calcium carbonate and magnesium hydrate, leaving a soluble sodium sulphate which does not harden water. The apparatus and plant used in applying the process were described and the results that have been attained discussed in a paper by Mr. W. B. Gerrish at the recent convention of the New England Water Works Association.

The water is collected about 6 miles from Oberlin and conveyed to the water works in a vitrified pipe conduit with cement joints which leak water into the ground from the conduit in dry seasons and admit ground water in wet weather. The soil is full of limestone pebbles which are acted on by the rainwater, rendering the water very hard. The raw water is stored in a large reservoir at the water works station and treated in two settling basins, with a capacity of 330,000 gal. each, which were formed by dividing an elliptical reservoir located between the storage reservoir and the pump well.

The chemicals are made into solutions in the pump house in tanks that contain mechanical agitators driven by a Pelton water motor. They are applied to the raw water in a mixing box 2x2 ft. in section and 40 ft. long buried under ground with its top at the water level in the settling basin when the basin is full. This box is watertight and under a slight pressure. It is provided with baffles, the lime water being admitted behind the first baffle and the soda solution behind the second one. The chemically charged water enters the bottom of the first settling basin through a perforated 8-in. galvanized-iron pipe 40 ft. long and is drawn from the top of this basin by a float arm and distributed along the bottom of the second settling basin through another perforated 8-in. galvanized-iron pipe. The settled water is drawn from the top of the second settling basin and passes to the pump well, from which it is elevated to a standpipe and on its way down through the standpipe passes through pressure filters.

The process was first applied in Dec., 1903, and has produced uniformly good results since its inception, the alkalinity of the raw water which reaches more than 14 gr. per gallon being reduced to 3 gr., or less, per gallon. There are certain difficulties in the operation of the plant, however, and Mr. Gerrish stated that the proportioning of the chemicals is a matter requiring very careful attention. The maximum amount of lime used in the past year was 17 gr. per gal. of water and the minimum amount 6 gr.; the maximum amount of soda was 6 gr. and the minimum 2 gr. to the gal.

The holes in the distribution pipe in the bottom of the first settling basin become filled with a hard formation of lime, which has to be removed every week and in six weeks the holes will become entirely stopped. The holes in the distribution pipe in the second basin become filled in about 6 months. This tendency of the treated water to form deposits where there is constriction and consequent rapid flow, is the one thing, Mr. Gerrish believes, to cause anxiety about the process. The precipitate in the first settling basin amounts to about 1 ft. a month, while in the second basin it was only about 4 in. in 20 months. The remainder of the apparatus used in the application of the chemicals and settling of the treated water and the pumps in the station have never been troubled by deposits or incrustations of sufficient amount to occasion any difficulty. A coating of carbonate of calcium and magnesium forms on the sand of the filters, however, which will eventually require the renewal of the sand.

No after precipitation has been noticed except in two cases where the water was warm and allowed to stand in that condition for some time. No deleterious results have been produced on meters and it is considered that if trouble should be experienced with deposits of carbonate of calcium in them it could be remedied easily by adding sufficient CO_2 to fix the carbonates.

The operation of the plant appears to indicate that the softening process requires considerable time. Each of the two settling basins contains twice the normal daily consumption and at times when the consumption is only one-third the amount contained in one of the settling basins, permitting 6 days' sedimentation of the treated water before filtering, the best results are considered to have been produced.

The chemicals for the treatment cost about 1 cent per 1,000 gal. of water delivered, while labor, interest and depreciation are said to add 1½ cents more, making the total cost about 2½ cents per 1,000 gal. of water treated and delivered to the pumps.

The bacterial efficiency of the process as applied is said to be uniformly high. A series of tests which extended over three weeks showed that 90 per cent. of the bacteria in the raw water were removed in the first basin and that the water delivered to the village contained on the average less than 5 bacteria per c.c.

The general plan for the application of the chemicals was conceived by Mr. C. Arthur Brown, sanitary engineer, of Chicago.

The Importance of Preliminary Tests of Paving Materials.

A paper read before the American Society for Municipal Improvements by J. W. Howard.

Paving is a branch of engineering which, like water works and other branches, demands a knowledge of past pavements from study, reading, correspondence, examination and experience, to enable the engineer to provide good specifications, tests and inspections, and thus produce efficient pavements for present needs, which, with minimum repairs, can be used by succeeding generations. As to cost, a city has so long a life that cheap maintenance not cheap first cost is true economy. The problem of what is the best pavement is a local one for each city and for each street. It depends upon the character, traffic, grade and other elements in each case. There are streets and avenues in every city adapted to gravel, macadam, telford-macadam, asphalt, bitulithic, brick, stone blocks or other pavement.

It is the duty of every city engineer, official or other person who has to do with street paving, to use or cause to be used the recorded, valuable and accessible experience in many cities in Europe and America, in laying and maintaining pavements. They should use, or order used, the well-established preliminary chemical and especially physical tests of paving materials, based upon practical and concurrent experience with past pavements. We thus avoid past failures and repeat former successes. Pavements have been so long in use that the accumulated experience is very great. We must read and travel a little to obtain it. No person, whether city employe or contractor should experiment at the expense of a city or rely only on local experience. Scientific principles, definite tests and methods of construction have been deduced.

The pavements of the principal streets of ancient Rome and her leading colonial cities, although now with worn surfaces, were a visible evidence to me, when I inspected some of them, that a solid foundation is a first requirement. The French engineers about 1770 provided a well-drained sub-soil and demonstrated that a water-free bed is essential to lasting success for pavement foundation. It then withstands settlement from water and disturbance from freezing. It is thus possible to use thinner and cheaper foundations.

The Scotch engineer, MacAdam, established his system about the beginning of the last century and made road surfaces of crushed stone, which, when properly selected and compacted, would bind together. All civilized nations soon adopted his methods. The French established definite methods of preliminary testing crushed stone for proposed use in macadam. Other governments, including ours, are following. The English engineer, Telford, about a century ago, improved on MacAdam's method, by introducing a foundation of large stone which acts as a combined drain and a foundation for the macadam surface.

The study and administration of paving is being placed more in the hands of engineers and, like other structures, with more economic and better results. The last 112 years has seen the development of stone block pavements, until we have some uniform and well-cut granite or equivalent block pavement, with joints closed with waterproof filler, all on a solid concrete or equivalent foundation. Too many granite and other stone block pavements do not even approximate the model work found in Washington, D. C., and a very few other cities of the United States and Europe. This is largely due to the lack of knowledge of the best kinds of block pavements and how to secure them by preliminary tests and requirements.

Asphalt pavement was successful in 1854 on Begere St., Paris. It steadily spread to London and important European cities, where it is still maintained in constant good order, on the principle that "a stitch in time saves nine." The celebrated French engineer, Leon Malo, who paved the street mentioned, is the father of asphalt pavements. It has been my privilege to be his guest in France and see his methods of testing and using asphalt paving materials. The asphalt pavements of Europe, with a very few late exceptions, are natural bituminous limestone. In 1871 in Newark, N. J., and finally, in 1876, in Washington, D. C., the American artificial asphalt mixture pavements took their start, being composed of about 90 per cent. of sand, etc., cemented together with about 10 per cent. of asphalt-cement, consisting of asphaltum and bituminous flux. These artificial mixture pavements depend for success upon constant extensive preliminary chemical and physical tests of their component materials, combined with experience. Tests of asphalt, sand and other parts of asphalt pavement mixtures, full technical specifications and inspection of construction, are more necassary than ever, because there are now many good competing asphalts. These tests must not be made by nor indicated, as is too often the case, by any man in the regular employ or controlled by any one asphalt interest. The tendency is to require purer and better asphalts, especially those not seriously affected by water. I have had occasion during the past two years to examine sixteen good asphalts from as many independent sources. Some of the principal tests of asphalts and bituminous composition pavements are the asphaltum, flux, asphalt-cement, bitumen, etc., for purity, nature and quality, cementing power, ductility, flow, penetration, stability by evaporation or distillation, etc. The sand and other substances present or proposed for the mixture must also be carefully tested, all by standard laboratory tests based upon experience with testing the materials, composition, etc., while laying or examining past and especially successful asphalt pavements.

Wood pavements, under constant conditions of moist climate, uniform traffic and constant repairs, have been in use in London for more than forty years. Of course many of the wood blocks are often replaced and all of them every three to seven years. Wood pavements, as a whole, especially in our wet and then dry American climate, have been failures. Nevertheless, there are a few streets of a few cities where wood pavement, properly laid and maintained, will be a luxury worth its cost. It is necessary to know the history, to use the preliminary tests of wood paving materials, and to have full specifications, to insure even approximate good results.

The rise of brick pavements began with small experiments between 1870 and 1885. Their increase during the past fifteen years has been large. They are used a very little in Holland and England. There are now about 168 makers of paving bricks in the United States. They produce many sizes and many qualities. Most of them are suited to only the lightest traffic. A score of makes of shale and a half dozen fire clay brick will bear medium traffic. There are a few special shale bricks, however, which will bear fairly heavy traffic and are suited to some streets in many cities.

Brick pavements are a class which demands very strict preliminary tests to secure good results. Brand will not do it, for even a brand varies at times. The principal tests are abrasion, cross breaking, water absorption, density, hardness and crushing, and there are also tests for free lime, potash, soda, the presence of cracks, uniformity of shape, material, etc. Paving bricks which pass definite standards and methods of tests will make good pavements for certain classes of streets. I have lately tested forty-two makes, a few of which passed the safe requirements.

Another class of pavement is what is called tar-macadam. It is being experimented with in a few English towns and in some Canadian and United States cities with light traffic. No definite quality of tar nor mixtures of tar and stone or gravel are used. Each place or company is trying its own mixture, sometimes calling it tar, bituminous or even asphalt macadam.

A special pavement called bitulithic, made of selected and prepared tar products or bituminous cement combined with graded crushed stone, etc., began its rapid rise five years ago, being the result of scientific examination of past experience, laboratory research and experiments. The theory and practice of bitulithic pavement depend for good results upon preliminary tests of materials and predetermination of mixtures, combined with rigid inspection of work in progress.

Without discussing granite and other pavements, not enumerated, sufficient has been said to show the importance of using standard, scientific chemical and physical tests, and examining of all materials previous to and during their use in pavements. The custom of certain cities relying on pavement guarantees and bondsmen is a bad one. No such method is followed in European cities; nor is it used for public buildings, bridges, waterworks, etc., in the United States. A street needs a good pavement, not a good bond alone.

Two Electric Locomotives have just been completed in the shops of the Los Angeles Pacific Ry. It is intended to put the new machines into service for freight hauling over the standard gage divisions of the Los Angeles Pacific, and also to handle the passenger traffic which this electric road is planning to take from and deliver to the Santa Fe and the Southern Pacific at Inglewood and Sunset stations respectively, for Venice and Playa del Rey. In this way the company expects to make ample provision for passenger traffic on exceptionally heavy days at this resort. At both of the above-named stations the steam trains will be switched to the tracks of the electric railway company, coupled to the electric locomotives and hauled down to Venice, and returned by the same route.

Structural Details of the General Electric Co.'s Power House, Schenectady.—II.

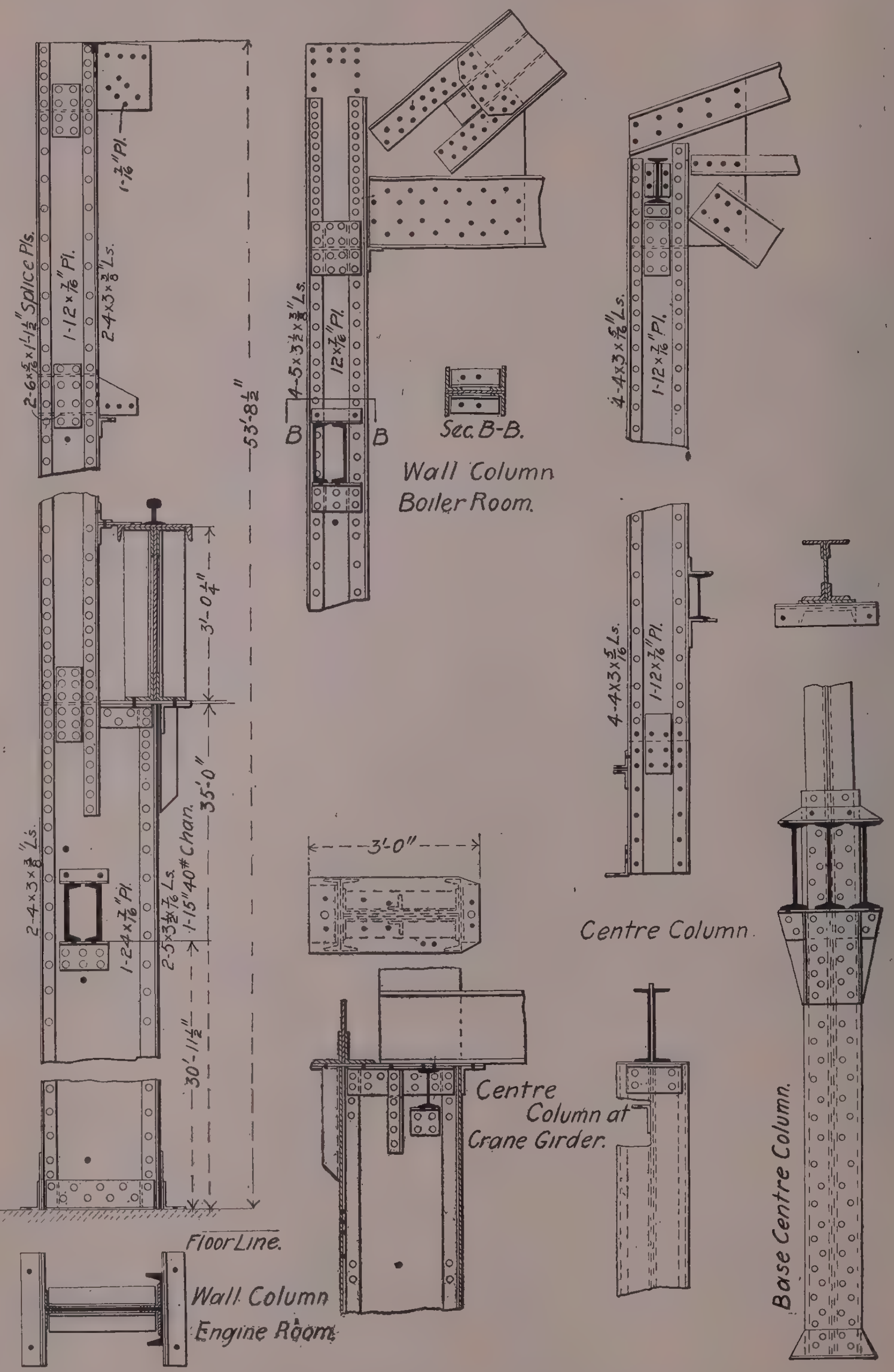
The lower sections of the outside boiler room columns are proportoined for 133-ton loads, and are made up with a 12-in. web and two pairs of 5x3½-in. angles. They are 37 ft. 11 in. long over all and support the boiler floor and the coal bunker trusses. Where the boiler floor girders are single I-beams they are seated on horizontal shelf angles riveted across the column flanges and in some cases projecting a little beyond the corner of the column to cantilever the I-beam. Below this connection one flange of the column is reinforced by a single 12x½-in. cover plate. Where the boiler floor girder consists of three I-beams the connection is similar except that the shelf angle is riveted to a short flange plate projecting beyond both edges of the column and has its horizontal leg reinforced by bearing on the planed upper edge of a distributing 12-in. channel instead of on a single vertical angle, as in the first case. At the upper end of the column the web plate is cut about 2½ ft. shorter than the flange angles and the latter project above it to form jaws shop-riveted to a connection plate which projects about 3 ft. above the top and 3 ft. beyond the inner flange to receive the field-riveted connections of the diagonal brace to the coal bunker girder and also forms the splice with the upper section of the column.

The upper section of the column is 25 ft. 10¾ in. long and is made with lighter flange angles than the lower section. At the top the flange angles project beyond the web plate and a wide connection plate is riveted between them, as in the lower sections, and forms receives the foot of the rafter and the horizontal and diagonal brace. In one column a portion of the intermediate section of the web is cut out and a plate is spliced in between the flanges there which projects beyond the inner face of the column and affords connection to field-riveted transverse diagonal and horizontal braces.

The engine room outer wall columns are proportioned for 112-ton loads and are 53 ft. 8½ in. long over all. They are made with a lower section extending to the bottom of the crane runway girder, and an upper section reaching to the top of the roof truss, but both sections are shop-riveted to form one piece in which the outside flange angles are continuous from top to bottom. The inner flange is offset to receive the runway girder in its plane and permit a reduction in cross-section of the upper part of the column which is loaded only with the weight of the roof, thus reducing the stresses and requiring much smaller cross section. The angles forming the inner flange at the top section are continued below the top of the lower section, splicing both sections together. The inner flange of the lower section is capped to afford a seat for the bottom flanges of the runway girders which abut there, and the horizontal flanges of the cap are reinforced by a short vertical distributing channel. Short sections of the web are omitted in the upper section of the column and in its place projecting plates are riveted between the flange angles to afford field-riveted connections for the top and bottom chord angles of the roof truss.

The runway girders are calculated to carry two 67,000-lb. concentrated loads 11½ ft. apart, with an allowance of 25 per cent. for impact. They have spans of 22 ft. 10 in. and 26 ft. 6 in., and are made with a 36x½-in. web and 6x6x9/16-in. flange angles. The upper flange is reinforced by a 15-in. channel and is secured to the column flange by a horizontal connection plate. The ends of adjacent girders are riveted together through their vertical web stiffener angles and are riveted to the column seats at the fixed ends and have connection bolts in slotted holes at their expansion eds.

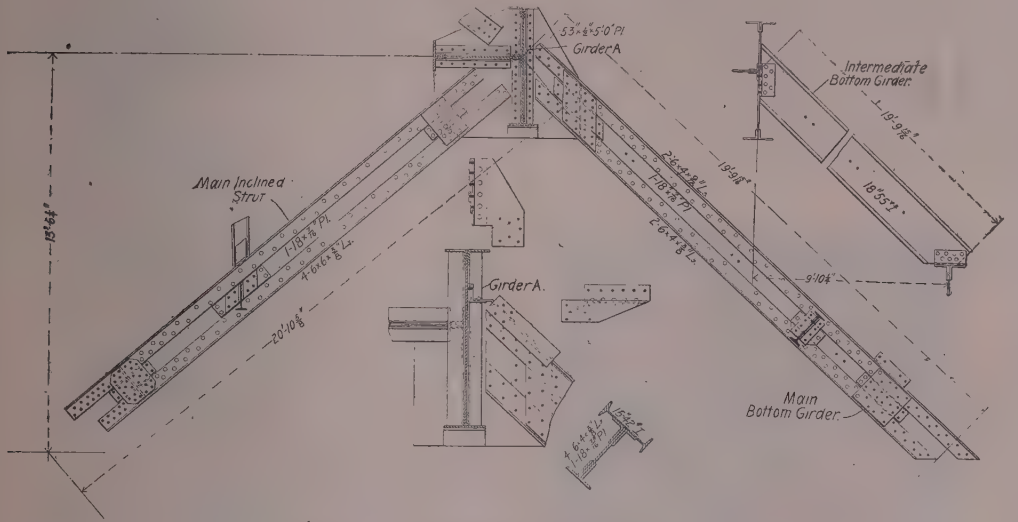
The columns between the boiler and engine room have a total height of nearly 64 ft., the same as those in the outer wall of the boiler room, and have a total load of 188 tons. They are made in two entirely separate sections, the lower one combining the principal features of the wall columns in the boiler room and in the engine room. The lower section, 34 ft. 4 in. long over all, is a plate girder with the 24-in. web transverse to the axis of the building. The flanges are reinforced with 15-in. channels, one of which is in the plane of the web of the runway girders and the other receives part of the weight of the coal bunker. Horizontal shelf angles with their flanges reinforced by vertical distribution angles are riveted to the web and flanges to support the beams and girders in the boiler room, and the foot of the column has horizontal flange angles on both sides of the web and on the flanges which are seated directly on the piers without any base plate. The 16x34-in. cap plate ½-in. thick is seated on the faced end of the column and its outer edges are supported on flange angles reinforced by vertical and horizontal angles.



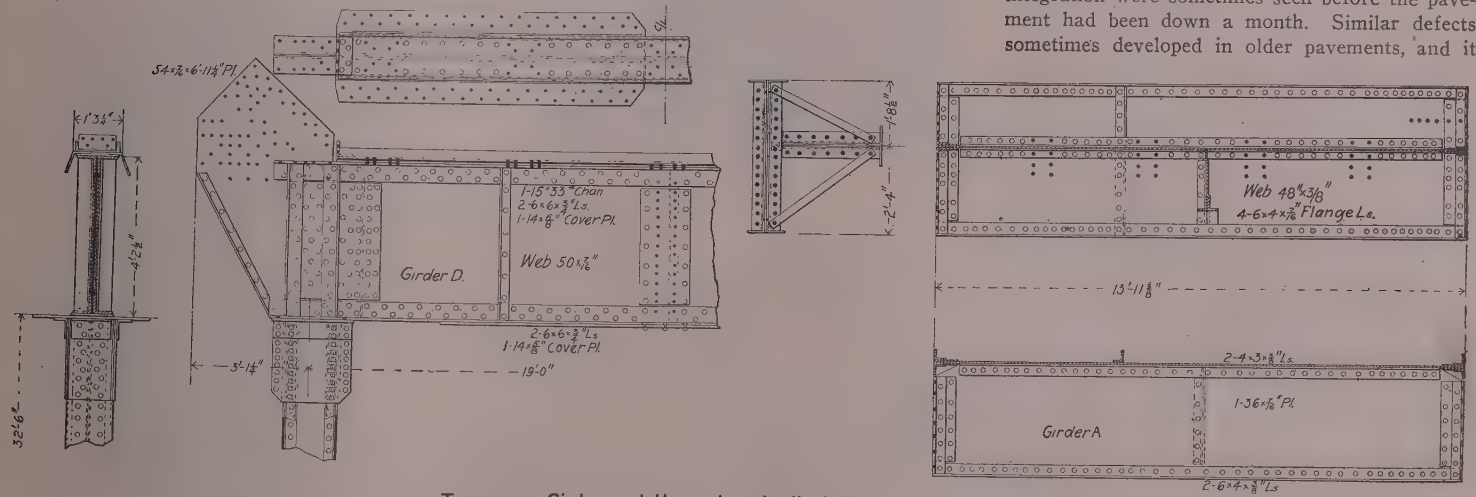
Principal Column Details Roof and Girder Connections.

The cap receives the abutting ends of the runway girders and the lower chords of the triangular trusses which carry the outside longitudinal girders of the coal bunkers. These chords are made with pairs of 15-in. channels, back to back, with ½-in. connection plates between their webs at the ends. These connection plates are field-riveted between the flanges of the upper sections of the columns and the web plates of the latter are cut shorter than the flanges to clear them and thus make the truss and column integral. The upper section of the column has an I-shape cross-section 12 in. deep.

The columns in the two center rows in the boiler room are 32½ ft. long over all and have loads of 400 tons each, due to the weight of the coal bunkers and their contents, to part of the roof load and part of the weight of the boiler floor. They also have H-shape cross-sections made with a plate girder web and two large channels, the flanges of which are connected by tie plates. They have no base plates but horizontal connection angles are riveted across all four sides at the lower end and are milled to bearing on the cast-iron pedestals to which they are secured by six anchor bolts. The beam and girder connections are made with reinforced shelf angles, as in the other columns, and at the upper end the flanges have short, thick cover plates and connection angles milled on the upper edges to bearing with the wide ¾-in. cap plate on which the coal bunker girders are seated.



Transverse Side Truss Supporting and Bracing Coal Bunker.



Transverse Girder and Upper Longitudinal Girder in Coal Bunker.

The triangular trusses supporting the outside longitudinal girders of the coal bunkers have their inclined members composed of plate girders with the ends of the webs cut shorter than the flange angles so that the latter form jaws engaging the connection plates. The inclined girders under the coal bunkers in the regular bents are made as shown in the general elevation, but at the ends of the bunkers the top flange of the girder is reinforced by a 15-in. I-beam which is web-connected to the longitudinal girder with a bent plate and angles, as shown in the detail. The apices of the two inclined girders of each triangular truss are connected to a ½-in. vertical plate, which is shop-riveted to the outside inclined girder and field-riveted to the other inclined girder and to the end connection angles on the longitudinal girders which abut on it, thus making a very simple and effective rigid connection with all rivets easily accessible for driving. Intermediate between the inner inclined girders the concrete arches forming the bottom of the bunker are supported on 18-in. I-beams parallel with the girders, which have beveled ends with web-connection angles shop-riveted to them and field-riveted to the vertical webs of the upper longitudinal girders and to the horizontal top flanges of the lower longitudinal girders.

The intermediate transverse girders, *D*, in the bottom of the coal bunkers, are like the special end girder shown, except that they do not have the top flange channel provided for the connection of the feet of the vertical end wall I-beams. Cover plates extending across the top flange and bent down on both sides to afford connection for the hopper bottoms are provided on the intermediate girders, and on one end girder which is designed to be connected to another hopper bottom when the future extension of the building is made. On the other end girders the plate has only one bent edge.

The upper longitudinal girders, *A*, in the sides of the coal bunkers correspond in general to the typical intermediate one illustrated. They have a 4x3-ft. T-shape cross section made with two plate girders shop-riveted together from end to end, and their ends are web-connected to the gusset plates at the vertices of the triangular trusses. The webs of the vertical portions are field-riveted to the upper ends of the intermediate inclined beams in the bunker bottom. The center longitudinal girders in the bottoms of the coal bunkers are simple plate girders with a 48-in. web and two 6x6-in. angles in each flange. The top flange, like that of the transverse girders, is reinforced by a full-length 30x⅜-in. plate with both projecting edges bent down to afford field-riveted connection to the inclined surfaces of the plates in the hopper bottoms of each panel. The end vertical flange angles or web stiffeners are field-riveted to the webs of the transverse girders. The adjacent longitudinal girders at the feet of the inclined sides of the bunkers resemble the center girders except that the top flange plates have bent projections on one edge only and that the girder webs are 50 in. deep, and that the ends of the bottom flanges are seated on brackets on the bunker columns, and there is no connection between their webs and those of the transverse girders.

The general designs were prepared under the direction of the engineering department of the General Electric Co., Mr. W. A. Parson, chief engineer in charge of building construction. The contract was awarded to the American Bridge Co., of New Jersey, Mr. Paul L. Wolfel, chief engineer. The 1,500 tons of structural steelwork was fabricated at the Athens, Albany, Elmira and Pencoyd plants from detail shop drawings prepared under the direction of Mr. J. H. Edwards, assistant chief engineer in charge of building construction. The field work was in charge of Mr. H. F. Lofland, erecting manager of the Eastern Division of the American Bridge Co. of New York, Mr. S. P. Mitchell, chief engineer. The sub-structure contract was awarded to the Buckley Construction Co., Plattsburg, N. Y. All concrete was made with Lehigh Portland cement.

Tar Macadam Pavements.

Tar macadam pavements have not fulfilled their early promises in Toronto, according to City Engineer C. H. Rust. In spite of careful selection and manipulation of materials signs of disintegration were sometimes seen before the pavement had been down a month. Similar defects sometimes developed in older pavements, and it was accordingly determined to make changes in the details of construction. It is proposed to increase the thickness of the foundation course from 4 to 5 in., eliminate the intermediate course and make the wearing surface 3 in. thick instead of 1 in. as formerly. The wearing surface of a tar macadam is believed to be the crucial factor. The proposed aim is to select such sizes of stone for the wearing surface as will make the densest aggregate, that is, one that contains the least percentage of voids. In the interests of simplicity it is decided to use only three sizes of broken stone, viz., 1½ and 3½ in. and screenings or crushed stone, varying in size from dust to ¼ in. in greatest dimension. A mixture of these three sizes in the proportion of two parts of 1½-in., one part of ½ in. and one part of screenings is found by careful experiment to give an almost perfectly dense aggregate and is adopted as the specified proportions to be used.

Lime Burning with Producer Gas.

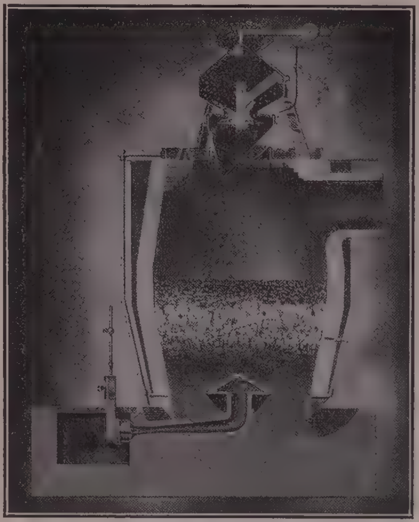
A producer has been furnishing gas for fuel for several months to two lime kilns run by the New England Lime Co., at New Milford, Conn., with entirely satisfactory results. The lime-burning works are close to the quarry where the stone is obtained and comprise a long, open shed built around a row of eight kilns, with a narrow-gauge railroad running from the quarry over the shed at the level of the top of the kilns. The latter are of the continuous-shaft type, 5x7 ft. in internal dimensions at the firing doors, 8½ ft. in inside diameter at the top and 31 ft. high. They are 40 ft. apart on centers and rest on a masonry footing about 8 ft. high, which extends the length of the shed, with an arched opening in the footing under each kiln. The walls of the lower 8 ft. of each kiln are considerably thicker than the upper part, and contain two firing doors and wood-burning grates, diametrically opposite each other. The stone is dumped into the kilns at the top from cars on the narrow-gauge track, and the burned lime is removed from the bottom of the kilns through discharging shears that open in the top of the arched openings in the masonry footing. The plant is operated continuously, and each kiln produces about sixty-five 300-lb. barrels of lime every 24 hr. when burning cordwood fuel.

The gas-producer installation is entirely an experimental one, and owing to the conditions under which it had to be made is crude in many ways. It has demonstrated, however, that producer gas is particularly well adapted for lime-burning, and that a producer installation can be applied to existing kilns with practically no reconstruction. The two kilns that have been fitted for gas burning in this plant are supplied with gas from a standard 8-ft. producer, made by the Morgan Construction Co., of Worcester, Mass. The producer is set between the two kilns at one side of the masonry footing, and is connected with the firing doors of the kilns by square sheet-steel ducts lined with fire brick. Slight changes only were required in adapting the wood-firing doors for gas firing, so wood firing can be resumed at any time.

A cross-section of the producer is shown in an accompanying illustration, from which its general arrangement may be seen. The producer consists of a cylindrical steel-plate shell contracted toward the bottom edge where it extends into a circular water-filled ash pan formed as a depression in the concrete footing. The shell is supported by four cast-iron feet resting on the concrete floor surrounding the ash pan, and is lined with hard firebrick. A number of sight holes are provided around the circumference of the producer about 3 ft. above the water level in the ash pan to enable the attendant to watch the zone of combustion and to correct any irregularity in the level of the coal. The top of the producer is covered by a shallow annular open cast-iron pan filled with water, and through the central opening in this pan an automatic coal feeding apparatus communicates with the interior of the producer. The blast is supplied by a ⅜-in. Körting steam jet blower connected to a central tuyere with a mushroom-shaped top. This tuyere rises from the ash-pan and distributes air and steam over the interior of the producer.

The producer is designed to operate continuously after the fire is started, and is supplied with coal automatically by the feeding device on top. Starting the producer is a simple operation. The producer shell is filled a little above the top of the tuyere with ashes, which are made perfectly level on top; a wood fire about 2 ft. thick is then built on top of the ashes and when it is well started coal feeding is commenced, the blower being started simultaneously with the fire.

The automatic coal feed consists of a hopper above a drum, with a revolving delivery spout extending into the producer at the bottom of the drum. The spout is revolved by a circular rachet gear on the circumference of its shell at the top by an arm attached eccentrically to a line shaft. The spout revolves on a central axis suspended from the inside of the drum. The joints between the spout and the drum and between the spout and the top of the producer are water-sealed. The hopper has to be filled once an hour at the rate gas has been furnished to the kilns, and the spout makes about one revolution every 5 min. Coal is passed from the hopper to the drum by lowering a trap diaphragm seal on the bottom of the hopper, while the rate of discharge from the drum into the spout is governed by the speed at which the latter is made to revolve. The coal is thus discharged uniformly over the firing bed and kept level without barring from the outside. Poke holes are provided, however, so any cavities that occur in the combustion zone may be broken down. The ashes may be removed from any point in the circular water pan forming the seal at the bottom of the producer.



The Morgan Gas Producer.

The ducts leading from the producer to the kilns are connected to the ash doors beneath the grates, and the air is admitted through the firing doors above the grates so combustion takes place immediately in front of these doors and over the grates. In the ordinary operation of the kilns the wood fires are allowed to burn out every 4 hr. and the burned lime drawn off through the discharging doors in the bottom of the kilns. It has been found, however, that the lime can be drawn every 3 hr. with gas firing, with a corresponding increase in the capacity of the kilns.

The ducts from the producer extend in opposite directions from it to the kilns with two branch connections to each kiln. The main duct leading to each kiln has an overlapping step-up joint in it at the first branch connection, with a soot door placed in the end of each part of the duct at the joint and a soot door at the junction of the distant branch with the main duct. The main ducts are also on hollow brick piers with soot doors at the bottom of them. The ducts being connected to the kilns at two points only have to be kept in practically continuous operation and cannot be burned out conveniently, as is the custom in operating most producer-gas installations for heating purposes. About 1-in. of soot collects in the ducts every 24 hr. and is drawn out by hand through the soot doors while the producer is shut down when lime is being drawn from the kilns. Experience in the operation of the plant appears to indicate that even better results than have been obtained could be produced if the gas was introduced to the kiln at four points, 90 deg. apart. An arrangement of ducts could also be made then which would permit the occasional burning out of soot in two branch ducts connected to a main duct from the producer on one side of the row of kilns, without interfering with the supply of gas from the other two branch ducts which could be connected to a main duct on the other side of the row of kilns.

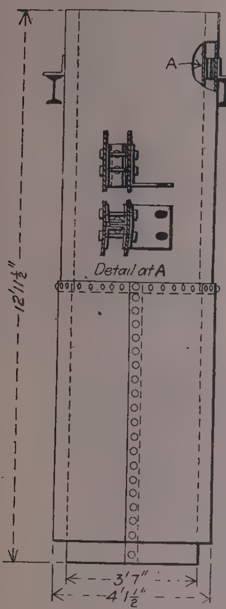
One man is required on each shift to burn each kiln and handle the burned lime from it when it is wood-fired, while with gas-firing in this experimental plant one man is required to operate the producer in addition to the one burner to each kiln. The temporary arrangement of the gas producer makes it impossible, however, to state just what the labor requirements would be for a gas-fired plant under favorable conditions. The coal for the gas producer of the present plant has to be elevated in wheelbarrows to a platform over the producer and shoveled into the hopper of the automatic feed by hand, while in a regular producer plant supplying gas for other heating purposes the coal is generally elevated by a conveyor into overhead bins and fed directly into the hopper. The steam for the blast of the producer is supplied by a boiler some distance away which also has to be fired by the producer operator. Furthermore, a plant containing three producers set up in the regulation manner could be handled by one operator and one helper to each shift and supply sufficient gas to fire eight kilns.

The actual saving of the gas firing over wood firing in the present experimental installation has been demonstrated by tests extending over considerable periods. After various difficulties with labor, the kilns, the irregularity of the coal supply and the general inadaptability of the lime plant to gas firing had been overcome; a two weeks' run under fairly favorable circumstances showed a saving of nearly 40 per cent. in fuel and an increase of 20 per cent. in the capacity of the kilns. Using Penn gas coal in the producer the kilns burned 3.7 lb. of lime per pound of coal, the coal costing $4.10 a ton delivered. This makes the fuel charge of 14.1 cents for the 285 lb. of lime in a 300-lb. barrel, and adding 3.1 cents, the cost of extra labor per barrel of lime in the gas firing under the present temporary conditions over wood firing, the total cost with gas firing for fuel and labor per barrel of lime is 17.2 cents. The cost of fuel and labor per barrel of lime with wood firing ranges between 25 and 28 cents, depending on the distance wood has to be hauled. The capacity of the two kilns during the two weeks' run, averaged 78.7 barrels each, but the operation of the plant since then has shown that 80 barrels per kiln can be produced easily with the gas-producer installation, as compared with 65 barrels to a kiln when it is wood fired.

The gas producer plant was designed and installed by the Morgan Construction Co., of Worcester, Mass., and its operation has been carried on by that company under the immediate direction of Mr. W. B. Chapman.

Seepage from Irrigation Canals is not only a waste of water, but may also result in the payment of damages for injury to property. A case of this nature was Howell v. Big Horn Basin Colonization Co., recently decided by the Wyoming Supreme Court. The canal in this case was constructed along a side hill above the plaintiff's premises, where a cut was made through sand-banks, and in two or three places a fill was made by scraping sand and gravel down from the side of the hill to form the bottom and lower bank of the canal. No care was taken to prevent leakage through this made ground, except by tramping the earth by teams. The court rules that such construction showed negligence, rendering the owners liable for injuries caused to the plaintiff's land by seepage from the canal.

A Double-Shell Telescopic Steel Stack.



The unlined steel stack for the First Day and Night State Bank building in New York City is 199 ft. high, 48½ in. in diameter outside and 42 in. in diameter inside. It is made in thirteen telescopic sections, each independently supported on the floorbeams of the successive stories and free to expand or contract at each joint. There are eight intermediate sections 12 ft. 2 in. long; the rest are from 12 ft. 4 in. to 33½ ft. long. Both the outer and inner shells are made with two or three courses of ¼-in. plates having a single longitudinal lap-riveted seam. The courses are alternately inside and outside, so that they fit accurately at the intermediate joints, which are shop-riveted, and at the end joints, just above the floor lines. The upper end of the lower section is an inside course, both shells being slightly tapered to slide easily inside the outer courses of the corresponding shells in the foot of the next upper section, which overlaps it about 3½ in. on the outside shell. The inner shell projects 6 in. beyond the outer one at the foot of each section so that in erection it can be first entered and guide the outer shell in making the joint, which proved very successful.

The outer and inner shells are fastened together, near the upper ends, by four radial spacers, each having an H-shaped cross-section, made of four short vertical angles riveted together and bolted between the shells. Opposite these spacers, short lug angles are bolted to the outside shell; these have slotted holes through their horizontal flanges, which are seated on the floorbeams, thus suspending each section independently of all others. The lower part of the top section corresponds to the intermediate sections and is suspended from the pent-house roof about 13 ft. above the lower edge and about 5 ft. below the upper edge of the outer shell, which terminates nearly 14 ft. below the top of the inner shell. The top of the outer shell is covered by a conical cap plate.

The furnace gases enter the stack through a long rectangular horizontal breeching about 18½ ft. above the bottom. The lower section of the stack is 23 ft. 9 in. long and is suspended 4 ft. below the upper edge, the bottom, which is closed with a concrete floor, being clear of the cellar floor. The stack was designed and built by Post & McCord, New York.

AN ELECTRIC RAILWAY EXPERIMENT of unusual interest is the Philadelphia & Western line now under construction from the end of the elevated railroad of the Philadelphia Rapid Transit system to Wayne, a distance of 12 miles. This is the first section of a line which, with its branches, will be 96 miles long. It runs over a private right of way paralleling the Pennsylvania R. R. for a considerable distance, and is intended for freight and passenger business. All culverts are built for a four-track roadbed, but only two tracks are being laid now. The track has rock ballast and 85-lb. rails, and the cars will have General Electric multiple-unit equipments.

Book Notes.

A few years ago, in a work on physical units, Mr. Olof Linders suggested a general system of letters for designating these units. It is admitted that the present absence of any logical method covering the whole domain of physics is a misfortune. The suggestion of Mr. Linders attracted so much attention that he has accordingly written "Die Formelzeichen," to illustrate three systems of notation. These he compares with fourteen other German, French, English and American suggestions. It is to be feared that the author has undertaken a task which the technical public does not yet care to support. While it is important and must be taken up sometime, the subject is not yet ripe for consideration, and the large amount of study and thought spent in the preparation of this interesting book is likely to be barren of any immediate results. (Leipzig, Jäh & Schunke, paper, 5 marks.)

Mr. M. N. Baker has revised the portion of his "Sewerage and Sewage Purification" relating to disposal, and thus brought this useful little book abreast of the times. It is not an engineering work, but is a handbook on an engineering subject for the use of administrative municipal officers and those wishing a general discussion of this branch of sanitation. The author's long experience as a public officer of a leading New Jersey community coupled with his intimate knowledge of sewerage and sewage disposal conditions here and abroad have enabled him to produce a reliable but non-technical explanation of one of the least understood branches of municipal work. There is no book on the subject in which the whole field is explained with any better judgment of the relative importance of all its details. (New York, D. Van Nostrand Co., 50 cents.)

A new edition of Prof. Thos. B. Stillman's "Engineering Chemistry" has appeared, in which much new matter has been incorporated, particularly on asphalts, lubricating oils, Portland cement and the technology of the products of the blast furnace. The line between chemistry and engineering cannot be drawn distinctly in a good many specialties. This has long been known in metallurgy, for some time in cement making, but only recently in water purification, the management of steam plants, and the selection of paints, oils and other materials, to mention but a few lines. The value of this book to chemists is a subject this journal will not attempt to estimate, but no doubt need be felt that the information it contains concerning boiler waters and their purification, the analysis of furnace gases, the valuation of fuels, the testing of cement and building materials, the properties of asphalt, and the selection of oils and paints will make it useful to a wide circle of technical readers to whose work the metallurgical portions are quite foreign. The tables are of special usefulness in many engineering computations. (Easton, Chemical Publishing Co.; cloth, 8vo, 619 pp. $4.50.)

The nineteenth annual report of the Commissioner of Labor is a volume of 976 pages devoted to an analysis of the course of wages and working hours from 1890 to 1903. The investigation necessary to secure the information lasted several years and furnishes a basis for an annual statement of the course of wages, if the work is continued. The figures are based on the returns from 3,475 establishments representing 67 industries with 519 different occupations. The information is as complete as possible in statistical work of such magnitude. For example, the wages paid and the working hours of steam fitters, stone setters, plumbers, bricklayers, sewer laborers, railroad carpenters and iron molders, to mention but a few classes, are given for different sections of the country and for leading cities, and in each case the number of establishments furnishing the data is stated. The figures show that in 1903, 26.5 per cent. more persons were employed in these 3,475 establishments than the average in the ten-year period of 1890-99, and they worked 3.4 per cent. less time, their weekly wages being 12.3 per cent. higher, however. The use of these figures requires care if serious mistakes are to be avoided in conclusions based on them, but with the elaborate introductory explanation concerning the manner in which they were compiled, no mistakes need be made.

The "Proceedings" of the sixth annual convention of the American Railway Engineering and Maintenance of Way Association form a volume of 872 pages. It is indispensable for railway engineers; in fact, a set of the six "Proceedings" ought to be kept in every division office, where they can be examined by anyone interested in railway engineering work. The great object of the Association for the present is to introduce more uniformity into methods for attaining the same ends on all railways. In other words, its present object is standardization, which is approached in a spirit well described by Mr. Hunter McDonald: "We have always shied at the word 'standard,' but on close investigation we will find that it is only a harmless stump on the roadside, not a bug-a-boo. There is no other word in our language which comes so near the one we need as this one. It is not immutable. The standard of to-day may be the derelict of to-morrow. What we want is a word that stands for the best we know how to do. What it represents may and will change from year to year, but the name will remain the same." A full report of the convention was printed in this journal last April, so it is unnecessary to review here the contents of the volume. A word of strong praise must be added for the painstaking editing. Whoever did the work has reason to be proud of it. The report is sold at the Association's offices, 1562 Monadnock Block, Chicago.

THE STATICALLY INDETERMINATE STRESSES IN FRAMES COMMONLY USED FOR BRIDGES. By Isami Hiroi. New York, D. Van Nostrand Co.: cloth, 12mo, 184 pp., $2.00.

The author of this book is professor of civil engineering at the Tokyo Imperial University, and it gives the substance of a series of lectures given to the students at that institution. It is particularly interesting as showing the manner in which the whole subject of stresses in framed structures can be developed from the method of work. This method is only used in this country for complicated conditions, and it is not generally known. Many of the problems to which Dr. Hiroi applies it are solved more quickly by the customary procedures, but on the other hand, it is of great value in the investigation of statically indeterminate stresses.

The author explains the fundamental principles of the method in an introductory chapter, and then takes up successively its application to trussed beams, viaduct bents, continuous girders, two-hinged arches, hingeless arches, suspension bridges and trusses with redundant members. Finally he discusses the secondary stresses due to rigidity of joints. It is evident that the title of the book is misleading to American readers. for a large proportion of the stresses he computes by the method of work are not considered statically indeterminate in ordinary practice. It is really a concise explanation of the application of Castigliano's theorems to the practical computation of bridge stresses, and its most useful feature is its explanation of both approximate and fairly exact methods of analyzing complicated truss conditions.

DIE AUTOMATISCHE REGULIERUNG DER TURBINEN. By Dr. Walther Bauersfeld. Berlin, Julius Springer; paper, 16mo, 216 pp., 6 marks.

Although the necessity of automatic regulators for water turbines has been recognized by the invention of many devices, it has remained for Dr. Bauersfeld to prepare in concise form a general description of them. His book relates only to the type in which a ball governor actuates through suitable mechanism either the gates of the turbine or a valve in the penstock leading to it. This leaves several relatively unimportant types with only a brief notice, but at present, this omission is not of any consequence.

The book is in three parts. In the first is an explanation of the action of a ball governor, following the analysis first published by M. Tolle about ten years ago and discussed by him at greater length in a book just printed on the governing of prime movers. This analysis will interest all designers of machinery using such governors, as it gives a very simple graphical method of studying their characteristics. This section of the book also contains an explanation of the purpose of the servo-motor and the damping devices for producing steady regulation.

The second portion of the book contains a theoretical investigation of regulating action. This action differs essentially according to whether the regulating valve actuated by the governor always causes the gates to move with the same speed or produces a speed proportional to the deviation of the valve from its mean position. The former class of regulators has been investigated by Proell, Léanté, Houkowski, Pfarr and Rateau, while Stodola has discussed the latter. Both these cases are discussed in considerable mathematical detail, and the second one is carried to the most complicated form of regulator, in which the gates are moved by a main servomotor which is operated by a smaller servomotor controlled by the governor. The author has also extended his theoretical analysis to include the action of those American regulators in which the dampening of the sensitiveness of the apparatus does not depend on an invariable relation between the speed of the governor balls and the position of the gates of the turbine. This type of construction was used by J. J. Rieter & Co., of Winterthur, in 1893, and is exemplified by the Woodward and Sturgess regulators. The author closes this section of his book with a very interesting discussion of the influence of the penstock on regulation.

Part three is a description of the regulators of Th. Bell & Co., Piccard, Pictet & Co., the Ateliers de Constructions Mécaniques de Vevey, Woodward Governor Co., Maschinenfabrik Augsburg, Thomann, Pfarr, Maschinenfabrik Geislingen, J. M. Voith, J. J. Rieter & Co., Escher, Wyss & Co., Replogle Governor Works, Elsässischen Maschinenbau Gesellschaft, Ganz & Co., Sturgess Governor Co., and Lombard Governor Co. Some of these companies make several types of apparatus. Their classification in this book is an interesting one, and brings out very clearly their essential theoretical differences and similarities, as well as their construction. Moreover, the author's analysis of their operation suggests points in connection with their installation which would probably be overlooked without such a mathematical study of the principles of regulation as he gives. In fact, the book as a whole is a welcome discussion of a decidedly complicated subject, for the indirect regulation of turbines by apparatus actuated only by the change in speed of the turbines themselves and not by the change in the load is far more involved than the governing of steam engines.

Letters to the Editor.

BEDDING HEAVY BRIDGE PEDESTALS.

Sir: With regard to the use of fillers under bridge pedestals, discussed in your article of Sept. 16, on the Quebec bridge, I would say that I believe the best plan is to set the pedestals directly on the masonry and so prepare the bridge seat stones as to be absolutely true. This plan we pursued for the pedestals, in pairs, of the Monongahela bridge at Pittsburg, each pedestal being 7 x 8 ft. The bridge seat stones are granite, with vertical joints, cut to ¼ in. and the whole bedding surface fine-axed to the water-level. Of course, this takes a good deal of time and is expensive, but gives bearing surfaces in absolute contact, as perfect as can be desired, with most satisfactory results.

Yours truly, ALFRED P. BOLLER.
New York, Sept. 26.

Sir: Regarding the use of lead for seating bridge pedestals on masonry and the use of canvas instead, as has been done at Quebec, I fully concur with the verdict against lead. Under heavy pressures it flows like beeswax, but I have never discovered that it had any tendency to crack the stones. Of the merits of canvas I know nothing, but I should fear that in time it might go to pieces from rot or oxidation.

So far as my own observation has gone, the best material for filling under pedestals is iron cement (iron borings and sal-ammonia) which if properly made, viz., with just enough sal-ammonia to start oxidation and no more, gives excellent results even under very heavy pressures.

Truly yours, ROBT. MOORE.
St. Louis, Sept. 25.

Sir: In the account of the Quebec bridge in your issue of Sept. 16 you refer particularly to the use of fillers under the main pedestals. I am fully in accord with the views there stated against the use of lead under such pedestals, as I believe this material is liable to do considerable harm by cracking the stone or by flowing into the joints and spreading them. If any filler is to be employed I believe the material described for use under these pedestals is as good as any that could be selected. I would personally, however, rather omit any filler under bridge pedestals, and for this reason I strongly favor the use of double posts over main piers for large structures of this character, instead of single posts, as such a double post does not increase the amount of metal used and cuts the area of each masonry bearing in half. If these masonry areas are thus reduced, and the bridge seat is carefully hammer-dressed after all the stones forming it are fully set in position, I believe the bearing secured will be as good as if an intermediate filler such as described in this article is used.

Yours very truly, HENRY W. HODGE.
New York, Sept. 25.

A PROBLEM IN RAILWAY CURVES.

Sir: In The Engineering Record of August 26 I notice an article by Antonio Llano on a problem in railway curves. As he rightly states, this occurs more often in street railway practice than on steam lines, and, in fact, with the street railway engineer it is an every-day proposition. The writer solved it in a simple manner a number of years ago by making up a diagram, a copy of which is enclosed. This diagram is for curves passing a street intersection at right angles, which probably covers nine-tenths of the cases that arise. Similar diagrams have also been prepared for 10 deg. each way from the right angle, which cover a number of other cases, so that the special cases are easily taken care of in making drawings for the particular problems. In fact, making drawings strikes me as much simpler than trying to figure out the problem as stated by Mr. Llano.

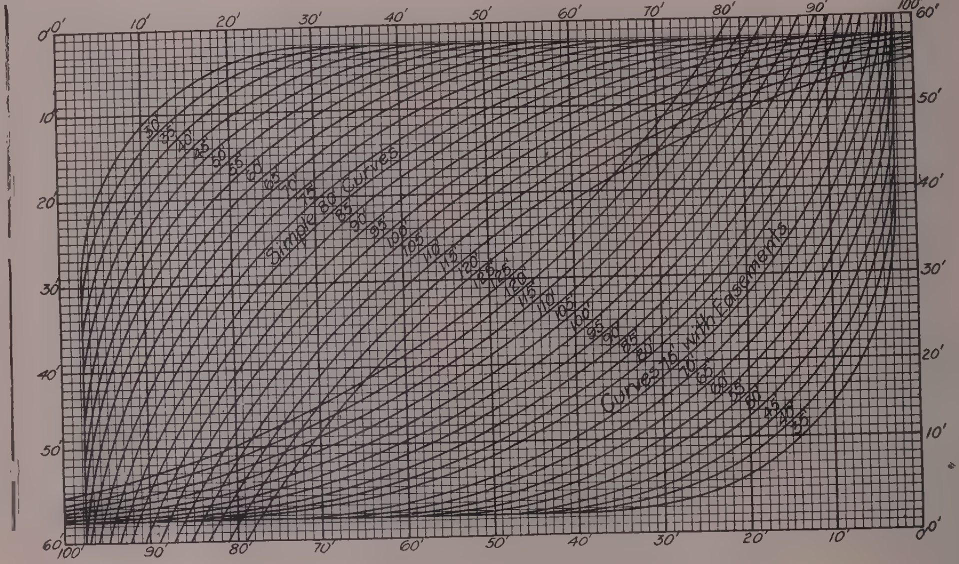


Diagram of Curb Clearances with Simple and Easement Curves.

The diagram gives curves showing the location of the inner rail of standard gauge track of the center radius given, and covers simple curves and those with easements. The outside lines of the diagram represent the center lines of the intersecting streets and the figures along them give the distance of the curb from the center line. A single case will show how the diagram is used. For instance, if it is desired to pass a simple curve around a corner, the width between curbs in one street being 20 ft. and in the other 50 ft., the diagram shows that the inner rail of a curve of 50 ft. radius will barely pass the corner if the curbs are carried out to a right-angle intersection.

Yours truly, MASON D. PRATT.
Harrisburg, Sept. 25.

THE STREET RAILWAYS of Greater London are eighteen in number and have a total length of 188.92 miles. Six of them, 61.65 miles long, are owned and operated by public authorities; two having a combined length of 59.7 miles are owned by public authorities and leased to companies, and the 67.7 miles of the remaining ten railways are owned and operated by private companies.

CURRENT NEWS SUPPLEMENT

OCTOBER 7, 1905.

DIRECTORY OF NATIONAL TECHNICAL AND TRADE SOCIETIES.

American Society of Civil Engineers. Secretary, Chas. Warren Hunt, 220 West 57th St., New York. Next meeting Oct. 18, paper on use of water for domestic purposes.

American Society of Mechanical Engineers. Secretary, F. R. Hutton, 12 West 31st St., New York.

American Institute of Electrical Engineers. Secretary, Ralph W. Pope, 95 Liberty St., New York.

National Fire Protection Association. Secretary, W. H. Merrill, Jr., Chicago.

American Institute of Mining Engineers. Secretary, R. W. Raymond, 99 John St., New York.

American Institute of Architects. Secretary, Glenn Brown, Washington, D. C.

Association of Engineering Societies. Secretary, Frederick Brooks, 31 Milk Street, Boston, Mass.

American Society of Heating and Ventilating Engineers. Secretary, W. M. Mackay, 235 Water St., New York.

Canadian Society of Civil Engineers. Secretary, Clement H. McLeod, 877 Dorchester St., Montreal.

American Public Health Association. Secretary, Dr. C. O. Probst, Columbus, O.

Society for the Promotion of Engineering Education. Secretary, Prof. M. S. Ketchum, University of Colorado, Boulder, Colo.

American Society for Testing Materials. Secretary, Prof. Edgar Marburg, University of Pennsylvania, Philadelphia, Pa.

American Society of Municipal Improvements. Secretary, George W. Tillson, Room 12, Municipal Building, Brooklyn, N. Y.

Association of Railway Superintendents of Bridges and Buildings. Secretary, S. F. Paterson, Concord, N. H.

American Railway Engineering and Maintenance of Way Association.. Secretary, L. C. Fritch, 1562 Monadnock Block, Chicago.

American Water-Works Association.. Secretary, J. M. Diven, Charleston, S. C.

American Foundrymen's Association. Secretary, Richard Moldenke, P. O. Box 432, New York.

Engine Builders' Association of the United States. Secretary, J. L. Lyle, 39 Cortlandt St., New York.

American Public Works Association. Secretary, W. H. Flint, Chattanooga.

Association of American Portland Cement Manufacturers. President, J. B. Lober, 1232 Land Title Building, Philadelphia.

National Association of Manufacturers of Sand-Lime Products. Secretary, H. A. Duerr, Wilmington, Del. Next meeting, Dec. 5-7, Detroit.

COMPLETION OF HUDSON RIVER TUNNELS OF THE NEW YORK & NEW JERSEY R. R. CO.

An important event in New York City's traction facilities occurred Sept. 29 in the completion of the tunnel system of the New York & New Jersey R. R. Co., under the Hudson River, between Hoboken and New York. The uncompleted south tube, which has been under construction from the Jersey side of the river, a few days ago reached the wall of the working shaft on the New York side, at Morton St. and the river front, and this wall was forced through on the date mentioned in the presence of the officials and directors of the company and of the Hudson companies, the construction corporation directly in charge of the prosecution of the work. The event was attended with considerable ceremony, marking the entire and successful completion of the under-river portions of this project. The officials and their guests entered the south tube through the entrance shaft near 15th St., Jersey City, from which all of the work of construction has been carried on, and rode to the barrier wall at the New York end, where Mr. W. G. Oakman, president of the Hudson Companies, operated the hydraulic jacks which forced the final opening through the wall and permitted the party to make the first complete trip through this tube.

Among those present in the party representing the New York & New Jersey R. R. Co. were W. G. MacAdoo, president, E. F. C. Young, director, C. W. King, secretary, and A. B. Conger, treasurer. The Hudson Companies was represented by W. G. Oakman, president, Pliny Fisk, director, W. N. Barnum, director, W. C. Kinney, treasurer, Wm. H. Barnum, asst. treasurer, Chas. M. Jacobs, chief engineer, J. V. Davies, deputy chief engineer, G. D. Snyder, principal asst. engineer, H. M. Sperry, consulting signal engineer, R. S. Courtney, works manager, F. K. Hilt, division engineer, and Dr. A. J. Loomis, medical director at the tunnel. Mr. L. B. Stillwell, consulting electrical engineer, was represented by Mr. H. Hazleton, his assistant.

The completion of these tunnels is of interest in that it marks the culmination of an enterprise that was projected over 30 years ago and, although regarded at that time as an impossible undertaking, was carried well along toward completion before being abandoned on account of engineering difficulties and lack of financial support. The tunnels were originally projected by De Witt Clinton Haskin, who began work upon them in 1874. In the early work, prior to 1890, brick construction had been use; when work was resumed, it was conducted by means of the shield and sectional cast-iron ring method which was thereafter employed throughout. Work was continued from 1890 until 1892 when, upon suspension, due to financial difficulties, there had been completed 3,916 ft. of the north tube eastward from the Jersey City shaft and 170 ft. westward from the New York shaft. Numerous references have been made in The Engineering Record to the principal events of this work and particularly the disaster of July, 21st, 1881, causing the death of 21 men by failure of an air lock, which was discussed in detail in the issue of July 20, 1895. A history of the work upon the tunnels appeared in the issue of August 14, 1897.

Work was taken up by the present company in 1902, after a delay of 10 years, and has been pushed to completion in record time. The remaining 1,700 ft. of the north tube were completed in March, 1904, and the work of lining with concrete and the installation of the cable ducts at the sides is well advanced. Now that the south tube is completed and the air pressure used with the shield method of construction is removed, similar work will be vigorously prosecuted there also. Work is progressing so rapidly upon the approaches that it is confidently expected that cars will be running over the system early in 1907.

The length of the tunnels between the shafts at 15th St., Jersey City and Morton St., New York, is 5,780 ft., the interior of each of the tubes being 15 ft., 3 in. The tubes are nearly parallel, separating only about 50 ft. toward the middle of the river, and have no cross communication at any point between the short shafts. The greatest depth below mean tide is near the middle of the river, where the tubes are 15 ft. below the bed of the river, the depth of water at that point being 65 ft. Each tube will provide for a single track, the north tube carrying west-bound traffic and the south tube the east-bound.

The New York approaches to the tunnels have been carried some distance eastward from the Morton St. shaft. Construction upon these is being carried out by the shield method, similar to that for the tubes beneath the river, the shields for the approaches having now reached Christopher St. The present plans for the New York terminal call for a line running up Fourth Ave. as far as 32nd St., with stations at 14th, 18th, 23rd, and 28th Sts. and a branch through 9th St. to make connection with the Interborough subway at Astor Place. The plans for the terminals on the New Jersey side of the river have not been definitely determined, but it is probable that connections will be made with the principal ferry terminals, so that incoming passengers may have the advantages of direct connections with the principal points of the city without the delays and inconveniences of the present ferry accommodations.

In order to expedite the excavation and lining, a special traveling machine was designed by the engineers to facilitate the handling of the lining and the removal of the muck. A pair of longitudinal horizontal skids 32 ft. long and about 7 ft. apart were braced together and supported on the vertical flanges of the sectional lining across which they slid. They had a cross-section made of Z-bars heavily reinforced and were attached to the shield by tension-rods, which were adjustable so that they could be used either to pull the skids forward when the shield was stationary, or to tow it when the shield was moved. A rigid horizontal platform about 8 ft. wide and 28 ft. long was mounted on rollers engaging each skid, and could be moved forward or back on the skids by means of a rack and pinion operated by its engine.

The platform was floored with ¾-in. steel plates. It supported a tower of four braced vertical posts about 3 ft. apart transversely and 15 ft. apart longitudinally. These columns were capped with longitudinal I-beams across which were seated transverse beams about 8½ ft. long. From their overhanging ends a horizontal steel track 32 ft. long was suspended on each side of the tower at a clear height of about 12 ft. above the invert of the tunnel. Each of these tracks had a rectangular cross-section of channels, Z-bars and angles riveted together so as to provide U-shaped channels on the lower edges of the webs inside. These channels were filled with a continuous line of very short transverse rollers, over 400 in each. On each line of rollers there was seated a channel bar about 28 ft. long. The pair of channels in each track were braced together to form a horizontal rectangular hollow boom which could be moved easily on the rollers and thus telescope with the track which enclosed it. On the inner flanges of each boom there was a trolley hoist moving from end to end and driven by a square horizontal shaft just below the track. This shaft was commanded by a hand lever at one end and was driven through a friction clutch and miter gear by the main engine.

The trolley hoist was traversed on its boom by an endless rope commanded by a sprocket chain at one end of the track and operated through a friction clutch by the engine. The trolley hoist moved back and forth on the boom without displacing the later, but near the forward end of the boom it engaged a stop on the latter and moved it forward, so as to project about 8 ft. maximum beyond the end of the main track. A telescopic cantilever was thus provided by which the trolley could be projected beyond the end of the platform and deliver the sections of lining to the hydraulic erector.

The tower which carried the overhead trolleys also supported a long digging arm with a movable horizontal pivot at the upper rear end. This arm could be revolved and moved longitudinally in a vertical plane so as to be thrust into the muck on the working platform of the shield. A transverse scraper blade was then automatically set to the required angle and as the arm was withdrawn and revolved downwards by the operating tackle, it developed an action somewhat like a hoe and brought a quantity of the muck to the foot of a steel apron inclined upwards from the front of the platform to a point just above the spoil car. The scraper pulled the load of muck up the incline and over its upper end into the spoil car, thus automatically loading it. The spoil car was then pushed across the platform by hand and down the return track on one side of the tunnel, while an empty car followed it from the track on the opposite side. The tracks on the tunnel floor were connected with those 1 or 2 ft. above them on the movable platform by means of hinged tail pieces which always engaged both of them. The cars ran to the front of the platform on trucks made with flat rails. Near the end of the platform these rails stopped and a wide angle curved to a semi-circle a little greater than the circumference of the outer rail was riveted to the platform so that its vertical flange formed a guide turning the car around on the smooth plate to engage the return track.

The rack and pinion gear enabled the machine to advance and recede as necessary for the mucking operations. The traveling hoist and the telescopic booms enabled the sections of lining to be handled by it independent of the position required for mucking. A vertical 30-h.-p. engine at the rear of the platform, driven by compressed air, furnished power through sprocket chains from the engine to the different parts of the machine.

The machine was built by the Cockburn Barrow & Machine Co., Jersey City, N. J. The same contractors also built exceptionally large air locks for the tunnel. These are 32 ft. long inside so as to admit material of large dimensions for the machinery and construction. They also built the dump cars used in the tunnel and equipped them with special clutches to engage the wire cable of the rope-hauling system. The north tunnel was equipped with a cable-hauling system installed by the John A. Roebling's Sons Co., described in The Engineering Record of July 25, 1903. A similar hauling apparatus was installed in the south tunnel by the Cockburn Barrow & Machine Co.

A NEW ROD FOR CONDUIT WORK.

In threading cables through conduits considerable labor is always involved in handling the rods. To reduce this to a minimum the Diamond Expansion Bolt Co., 9 Murray St., New York, has recently designed a system of rods which are rigid while in the ducts, but can be deflected considerably while crossing a manhole. The rods are of hickory and at the joints are furnished with pairs of chilled iron wheels. These wheels keep the sticks from touching the walls and reduce the work required to push the rods through the ducts. They also clean the duct and serve to gauge its condition, making it certain that a 2 1-2 in. passage is open. It is impossible for the rods to become detached while in a duct, as the rear end of a 3-ft. stick must be raised 20 in. before it becomes uncoupled.

BUSINESS NOTES.

The Westinghouse interests are factors in a new company which has been organized under the name of the Holland-American Construction Co., incorporated under the laws of the State of New York. The capital is $1,000,000. The original organizers of the Holland-American Construction Co. were J. F. Alden, at one time prominently connected with the American Bridge Co; Ralph George Kaebler, H. C. Brewster and C. H. Palmer, of Rochester. Four out of five of the directors are Westinghouse men. They are Newcomb Carlton, fourth vice-president of the Westinghouse Electric & Mfg. Co.; George C. Smith and Walter D. Uptegraff, of the Security Investment Co., of Pittsburg, of which concern George Westinghouse is president, and Joseph H. Lukach, who is one of the directors in the British Westinghouse Electric & Mfg. Co., Ltd.

The International Acheson Graphite Co., of Niagara Falls, N. Y., with the recent completion of a large extension equipped with the most modern electrical and mechanical appliances and machinery, has doubled the capacity of its plant for creating graphite in the electric furnace, and has closed a contract with the Niagara Falls Power Co. for another 1,000-h.-p. of electrical energy in addition to the 1,000 h.-p. previously used. The commercial importance of this artificial graphite may be estimated from the fact that the United States Geological Report for 1904 states that for that year the value of Acheson graphite produced was $217,790, while all the graphite mined in this country amounted merely to $341,372. New York State, which is considered rich in deposits, according to the official report of 1904, produced natural graphite worth $119,509. Acheson graphite is largely used in the manufacture of metal protective paints, dry batteries, stove polish, packing and as a lubricant. The electrochemical processes also consume an extensive supply.

The rapidly increasing business of the Morse Chain Co. has necessitated the building of a large new plant at Ithaca, N. Y., which will be operated in conjunction with the present factory at Trumansburg, N. Y. It is the intention of the company to make this new plant a model one in every way and ample facilities for future expansion will be provided. The main building, which will contain the general offices, will be three stories in height and will measure 64 x 303 ft. over all. The first floor will be used for the machine shop and a floor space of 64 x 236 ft. has been set apart for this purpose. The other buildings to be provided will be one story in height and their general dimensions are as follows: Foundry, 68 x 135 ft.; forge shop, 36 x 86 ft.; pattern shop, 82 x 28 ft.; power house, 105 x 45 ft. Steel and concrete have been used throughout in the construction of this plant and everything has been done to provide for an equipment in keeping with the advanced machine shop practice of the times. This is illustrated by the fact that gear cutters, boring mills, lathes and general plant equipment to the amount of $50,000 will be installed, a greater portion of which has already been purchased. The machine shop will be equipped with 10-ton electric traveling cranes as the light nature of the material under construction does not warrant the installation of very heavy cranes. The foundry will be equipped with electric cranes of 15 tons capacity having a span of 50 ft.

England has heretofore practically controlled the sale of terne or roofing plates to other countries than the United States, but an interesting instance of American success in this line is reported by Merchant & Evans Co., Philadelphia, successor to Merchant & Co., Inc., manufacturers of roofing plates, metal Spanish tiles and "Star" ventilators. This company reports that its Chicago office has completed shipments amounting to 30,000 sq. ft. of Merchants Old Method roofing tin for the American Legation buildings, at Pekin, China.

The Ingersoll-Rand Co., 11 Broadway, New York, announces the establishment of a branch office at Houghton Mich., under the management of Mr. T. F. Lynch, who has for several years past represented the Ingersoll-Sergeant Drill Co. in the copper and iron districts of the north. At the new office a complete stock of repair and duplicate parts for all Ingersoll-Rand machinery will be carried.

Among the orders received by the Ernst Wiener Co., 68 Broad St., New York, during the last month was one from a Central American railroad for 30 platform cars, 30 ft. long, 8 ft. wide, 3 ft. 8 in. gauge, with diamond trucks.

The Morris Machine Works, Baldwinsville, N. Y., have recently broken ground for two additions to their machine shops; one of these will be 216 x 45 ft., the other 150 x 58 ft. With the improved facilities which this additional floor space will give, the company will be able to make quick deliveries, and keep pace with the steady increase in its business.

The American Car & Foundry Co. has recently added to its equipment at the Madison Plant, Granite City, for the construction of steel and composite cars, 100 Boyer long-stroke riveting hammers, made by the Chicago Pneumatic Tool Co. The latter company reports that business in general continues good and the prospects for the remainder of the year are very bright.

The Ambursen Hydraulic Construction Co., of Boston, is now building from its own plans a reinforced concrete dam 27 ft. high for the Water Commissioners of Goffstown, N. H.

The Ideal Stoker, 114 Liberty St., New York, has closed a contract for a stoker installation at the Bayonne, N. J., works of the Para Recovery Co.

Producer gas for heating large forges is attracting much attention at present, and the Morgan Construction Co., 40 Exchange Place, New York, reports the sale of six producers for this purpose to the Babcock & Wilcox Co., at Bayonne, N. Y.; and four to the Pennsylvania R. R. Co., for its Altoona Shops. Among other sales of continuous automatic gas producers are two to the Cambria Steel Co., at Johnstown, Pa. The latter case is especially interesting as a recognition of the fact that this type of producer is the only one available for handling an inferior local coal successfully.

The uniting of The Lord & Burnham Co.. Hitchings & Co., Pierson-Sefton Co., under the firm name of Burnham-Hitchings-Pierson Co. brings under one control all the various patents and devices owned by the individual companies. Their sash-operating devise for raising sash in monitors, factories, shops and store buildings, is extremely simple in its operations. It is based primarily on the worm and gear; is free from chains, cables or a complicated series of wheels or cogs; will operate with perfect ease long or short ranges from any given point, and is self-oiling and self-locking. The several companies have made sash operating devices for over fifty years.

Lindon W. Bates is stated to be ready to take a contract for constructing the Panama Canal according to any one of the projects proposed by him for this undertaking. The company of which he is the head has as members the Deutsche Bank of Berlin and representatives of some of the largest financial institutions in the United States. The price on which he is willing to undertake the construction differs somewhat with the plan selected, the three alternative figures amounting to $120,000,000, $134,000,000 and $145,000,000.

A connection of a 30-in. new water main with an old main of the same size in service has been made at Trenton by the Water Works Equipment Co., of New York. The jointing machine was run by a gasoline engine. This is one of the largest connections ever made without shutting off the water service.

Contracts have been closed with the following parties for Parker boilers: Philadelphia Rapid Transit Co., 16 double-ended boilers, with superheaters and stokers, for their new power station on the Delaware River. This station is designed to contain 64 of these boilers, each unit being capable of developing 1000 boiler h.p. without forcing. This is the fifth order from this company, who already have over 10,000 h.p. in use. J. B. Stetson Co., 8 double-ended boilers to develop 5,000 h.p. without forcing. Single-ended boilers as follows: Bergdoll Brewing Co., Philadelphia, four 325 h.p.; California Pottery Works, one 175 h.p.; Shreve Building, San Francisco, two 85 h.p.; San Francisco Gas & Electric Co., one 262 h.p.; Presidio Fruit Canning Co., San Francisco, one 106 h.p.; M. Van Orden Co., Houghton, Mich., one 100 h.p.; St. Mary's Mineral Land & Canal Co., Toivola, Mich., one 100 h.p.; Champion Copper Co., Painesdale, Mich., one 250 h.p. for 300 pounds pressure.

The grouting machine in use on the Battery-Brooklyn tunnel, illustrated Sept. 9, 1905, is manufactured and controlled by the Cockburn, Barrow & Machine Co., 240 Eleventh St., Jersey City. This machine is used on all the tunnels around New York, giving good satisfaction.

The Allis-Chalmers Co. has shipped to San Francisco a consignment stock of Gates rock and ore breakers of various styles and sizes, together with standard repair parts. It will be of interest to the customers of the company to know that by this arrangement they will be able to secure prompt delivery of repair parts for their machines. This venture will also enable the company to make immediate shipment of complete crushers required in that part of the country, or in the islands of the Pacific. The company's San Francisco offices are located in the Rialto Building.

The Sullivan Machinery Co., of Chicago, reports the addition of two branch offices to its list, one at Knoxville, Tenn., and one at Joplin, Mo. The Knoxville office, with quarters in the Houston Bldg., is in charge of Mr. E. L. Thomas, for several years connected with the New York branch. Rock drills, stone channelers and quarrying machinery are carried in stock. Mr. S. A. Allison, who has been the company's representative at Joplin for the past two years, now becomes district manager at that point. A stock of Sullivan compressors, rock drills and duplicate parts and supplies is carried at the company's warehouse at Joplin. The new office is in the Keystone Hotel Block, corner of 4th and Virginia Ave.

The Bury Compressor Company, of Erie, Pa., reports a gradually expanding export, southern and western trade. Among the several orders received from France and Belgium, through Fenwick Freres & Co. during the month of September, is included one for the French Government. This company has a compressor on exhibit at the International Exhibition at Liege, Belgium, which is considered responsible for some of the sales in that section.

The Dayton Pneumatic Tool Coo., Dayton, O., has received an order from the American Car & Foundry Co. for fifty of their "Green" long-stroke riveting hammers. This is one of the largest single orders ever placed for this class of machinery. The tools on this order are to be all one size, having a piston diameter of 1⅛x8-inch stroke, and are for use in the new steel underframe department of the American Car & Foundry Co., Madison, Illinois.

The foreign business of the Chicago Pneumatic Tool Co. is growing rapidly and promises to rival that in this country in a few years. During President J. W. Duntley's recent European trip the Fraserburgh and Berlin factories were started up and manufacturing arrangements were perfected in Russia. Mr. Duntley brought home a number of large orders, particularly for air-cooled electric drills, which came from parties impossible to interest in air tools. Domestic orders continue heavy, among those recently taken being the following: Compressor and complete equipment of pneumatic tools for the Western Steel Car & Foundry Co., Hegewisch, Ill., three compressors each of 750 cu. ft. capacity for the Baltimore & Ohio R. R., one 2,000 ft. compressor for the Buffalo plant of the American Shipbuilding Co., one 1,000-ft. compressor for the Huntington shops of the Chesapeake & Ohio R. R., one 1200-ft. compressor for the Norfolk & Western R. R., one 1250-ft. compressor for Otis Steel Co., Cleveland, O., and one 1650-ft. and two 425-ft. compressors for Bartlett & Hayward, Baltimore, Md. A total of 157 Franklin compressors have been sold during the past 90 days, therefore it is easily seen that the pneumatic tool business promises well for the balance of the year.

The Corps of Engineers of the Ministry of Public Works of Peru requests American manufacturers of equipment and supplies employed in bridge building, railway construction and highway construction to send their catalogues to its main office in Lima.

The Lunkenheimer Co., Cincinnati, has recently made improvements in its regrinding valves. These are not radical, as a half century's use has proved the general design to be satisfactory. The weight has been increased as a precaution against injury by rough handling when attaching them, and a change has been made in the patterns by which the unobstructed passage through the valve is increased to exceed that of the connecting pipe. The pipe threads have been made considerably longer, to avoid the danger of stripping them when unskilled persons attempt to fit the valves.

The Robins Conveying Belt Co., of New York, has recently obtained contracts for large coal pockets and conveying machinery for the Erie R. R. Co., at Buffalo, N. Y., and at Port Jervis, N. Y. They are also completing orders for belt conveyors intended for paper mills in Sweden and have an order under way from the Power & Mining Machinery Co., for a belt conveyor for handling ore.

During the past month orders have been received by the Westinghouse Machine Co. for no less than 51 Roney mechanical stokers, ranging in size from 54 x 20-in. grate to 132 x 26-in. grate, the largest of the orders being that of the Pennsylvania R. R. for six 132 x 26-in. and five 100 x 20-in. grate stokers. A large order from the Ohio Hospital for Epileptics at Gallipolis, Ohio, has also been received and others from the American Bridge Co., Ambridge, Pa.; National Tube Co., Pittsburg, Pa.; Detroit United Railway, Detroit, Mich.; York Engineering Co., York, Pa.; Proctor & Gamble Co., Cincinnati, Ohio; the Union Rolling Co., Cleveland, Ohio; Gulfport & Mississippi Coast Traction Co., Gulfport, Miss.; United Presbyterian Board of Publication, Pittsburg, Pa.; Indiana Boys' School, Plainfield, Ind.; B. & O. Office Building at New York City, and the Railway Exchange Buildnig at Chicago, Ill.

The Abner Doble Co., of San Francisco, announces that the University of Michigan has purchased the tangential water wheel which it exhibited at the St. Louis World's Fair and for which the company was awarded the grand prize. This wheel is to be installed in the hydraulic laboratory of the new Engineering Building at Ann Arbor, Mich., where it will be mounted in connection with a duplex pump for experimental purposes, its output being 100 h.p. when operating under a head of 580 ft. The 12-in. laboratory water motors which the Abner Doble Co. builds for technical schools and universities have attracted considerable attention among the engineering faculties of many of the leading educational institutions, and the interest shown in these small water wheels has resulted in an increasing demand for them, orders having recently been received from the University of Wisconsin, the Michigan School of Mines and the University of Toronto.

The Marine Manufacturing & Supply Co., 158 South St., New York City, is moving its manufacturing department to New Brunswick, N. J. The new plant occupies the larger part of a city block and includes iron and brass foundry, machine shop, blacksmith and pattern shops, etc. The company is in the market for new machinery and will be glad to receive catalogues.

The Sullivan Machinery Co. has recently shipped to Colon, Canal Zone, Panama, 25 rock drills, size UH-11 (3⅝ inch), fitted with the new Sullivan tappet valves, for the Isthmian Canal Commission.

The Reeves Engine Co., through its Western manager, Joseph B. Hall, of Chicago, has arranged with the Dwyer Heating & Plumbing Co., of St. Paul, Minn., to handle the territory tributary to St. Paul. Mr. F. J. Spriggs will be in charge of engineering matters for the Dwyer Co.

The Dayton Hydraulic Machinery Co., Dayton, O., has moved its Chicago office from 474 Carroll Ave. to 536 Monadnock Block; Mr. Edwin M. May will be district manager; Frederick Myers, city sales agent.

PERSONAL NOTES.

Mr. L. M. Rice, of Seattle, has been engaged as chief engineer of the Port Angeles & Peninsular R. R.

Mr. C. P. A. Lonergan has become assistant engineer on the Oregon Short Line R. R., at Salt Lake City, Utah.

Capt. Harry Whitburn has been engaged as superintendent of the tunnel of the Michigan Central R. R. under the Detroit River.

Mr. Wm. Barclay Parsons has resigned his connection with the investigation of the work on the Philadelphia water purification undertakings.

Mr. R. J. Davis has been reappointed operating manager of the Elmira and Brooklyn plants of the Empire Bridge Co., with offices at Philadelphia.

Mr. W. G. Edmonson, of the Altoona shops of the Pennsylvania R. R., has been appointed engineer of tests of the Philadelphia & Reading Ry.

Capt. Charles Keller, Corps of Engineers, U. S. A., has been ordered to relieve Col. G. J. Lydecker as engineer of the Eleventh Light House District.

Messrs. C. W. Simpson and Jos. Matousek have joined the engineering staff of the bridge department of the Delaware, Lackawanna & Western R. R., at Hoboken, N. J.

Mr. C. M. Ingersoll, chief engineer of the New York, New Haven & Hartford R. R., has been placed in charge of the department of real estate, taxes and law of the system.

Mr. N. D. Miller, of Vancouver, Wash., has been appointed chief engineer of the Portland & Seattle R. R., now being built down the north bank of the Columbia River from Kennewick to Portland.

Mr. Holmes Hollister has resigned his position of superintendent of the Ithaca, N. Y., water department on account of ill health, but will remain a commissioner. He has been succeeded by Mr. Frank L. Getman.

Mr. Robert McF. Doble, consulting engineer of the Abner Doble Co., San Francisco, has been traveling for several months in Mexico and Colorado in order to examine several important long-distance hydro-electric power projects.

The officers of the American Street and Interurban Railway Association elected last week are W. Caryl Ely, Buffalo, president; John I. Beggs, Milwaukee, Calvin G. Goodrich, Minneapolis, and J. L. Shaw, Boston, vice-presidents.

Mr. John C. Ostrup, M. Am. Soc. C. E., formerly designing engineer of the Boston Elevated Ry. and afterward in private consulting practice in Boston and New York, has become vice-president and chief engineer of the American Engineering Co., Indianapolis.

Prof. S. Takata, of Tokyo, in addition to his college duties, is now consulting engineer on the quay work of the Yokohama custom house, engineer to the Government Printing Bureau and Paper Mills, and engineer to the Home Department and the Patent Jury.

Mr. A. S. Zinn, recently principal assistant engineer of maintenance of way of the Rock Island System, has been appointed assistant to the chief engineer of the Chicago & Western Indiana R. R. and the Chicago Belt Ry., and will devote his time to track elevation work.

Mr. T. C. Moorshead has been reappointed chief engineer of the Illinois Terminal R. R., at Alton, Ill. Mr. B. B. Stakemiller has resigned as engineer of maintenance of way on that road to become connected with the engineering department of the Missouri Pacific R. R. at St. Louis, Mo.

Edward L. Bartlett, who died Sept. 29, at Baltimore, was a member of the firm of Bartlett, Hayward & Co., of which his father was a member before him. He served an apprenticeship in the works and was tested in the business department before being admitted to the firm, which has developed largely under his direction and that of Mr. Thomas J. Hayward, his partner.

Mr. Kenneth B. Thornton has been appointed operating engineer of the Canadian White Co., of Montreal. He studied electrical and mechanical engineering at the Central Technical College, London, and then entered the works of the Royal Electric Co., where he remained until recently, much of his work being in connection with the enterprises of the Montreal Light, Heat & Power Co.

Mr. Wm. R. Billings, formerly treasurer and general manager of the Taunton Locomotive Mfg. Co., has become connected with the Alberger Condenser Co., of New York and Chicago, and will be in charge of the company's business in Wainwright feed-water heaters and expansion joints. The changes leading to the transfer of ownership of these well-known specialties were mentioned in this journal on Sept. 2.

Sutherland M. Prevost, third vice-president of the Pennsylvania R. R., died at Philadelphia, Sept. 30. Like most of the officers of the company he began his career in the engineering department, which he entered in 1864 as an engineer. By 1871 he had risen to the rank of assistant engineer, from which he was transferred to the operating department as superintendent of the Bedford division. In 1882 he was made general superintendent and in 1885 general superintendent of transportation. In 1893, he became general manager, and in 1897 third vice-president.

Mr. August Ziesing, president of the American Bridge Co., announces that Mr. Emil Gerber, in addition to his work as assistant to the president, will assume the duties of operating manager of the Pittsburg Division, covering the Ambridge, Canton, Shiffler and Toledo plants; his office will be at Pittsburg. Mr. R. J. Davis will assume the duties of operating manager of the Eastern Division, covering the Athens, Berlin, Edge Moor, Pencoyd and Trenton plants; his office will be at Philadelphia. Mr. E. A. Smith will assume the duties of operating manager of the Western Division, covering the American, Detroit, Lafayette, Lassig, Milwaukee and Minneapolis plants; his offices will be at Chicago.

Mr. W. T. McCaskey, lately manager for Agar-Cross & Co., London, has become special representative of the Allis-Chalmers Co. for important contract work like the equipment of interurban electric railways and the construction of hydro-electric plants. He began his electric work in 1882, when he assumed charge of the plant of the Eau Claire Electric Light & Power Co. Later he was connected with the Sperry interests in Kansas City and operated an electric lighting plant in Fort Worth. From 1889 to 1894 he was on the Pacific Coast for several companies and then returned to Chicago as representative of the Standard Electric Co. In 1899 he went to Buenos Ayres for the Westinghouse interests, and remained there for a couple of years, going thence to London. His headquarters will be in London. A recent promotion in the Allis-Chalmers Co. is that which moves Mr. O. A. Stranahan up from manager of the Power Department to the position of Sales Manager. His offices will be in Milwaukee, and he will be assisted by Mr. M. C. Miller.

William B. Rankine, who died at Franconia, N. H., on Sept. 29, was widely known in engineering circles on account of his important relations to power development enterprises at Niagara Falls. He was a lawyer by profession, and it was while he was in practice at that city that he first conceived the idea of utilizing the great natural forces in the Niagara River and Falls for the production of power for commercial purposes. While in New York City, where he continued his law practice, he met prominent financiers and interested them in his plans. After seven years he finally succeeded in forming a power company called the Niagara Power Co., and became its secretary and treasurer. Later he was made a vice-president. In the company were D. O. Mills, E. D. Adams, F. I. Stetts and other well-known capitalists. Mr. Rankine always acted as the chief executive of the company, and spent his time between the works and the main office in New York City. Eventually he went again to live in Niagara Falls. He was an officer of various affiliated companies of the Niagara Falls Power Co., the Natural Food Co., and other important commercial enterprises.

The announcement that Mr. Fayette S. Curtis, second vice-president of the New York, New Haven & Hartford R. R. Co., will hereafter have charge of all the company's business in Boston, probably indicates that for some time to come he will not devote any time to engineering matters. He began his engineering work in the summer of 1863, when he was employed by the Albany & Susquehanna R. R. Co., in the location and construction of a line between Binghamton and Albany; in 1866 he was engaged by the Southern Central R. R. Co. in railroad location and construction between Oswego and Auburn, and in 1869 rendered similar service for the Lake Ontario Shore R. R. between Oswego and Rochester. From the spring of 1869 until 1871 he was assistant engineer in making surveys for the town of Tremont and Fordham, now included in New York City. In 1871 he represented the Harlem River & Port Chester R. R. Co. in the location of lines between New Rochelle and the Harlem River and in the fall of 1871 was employed by the New York & Harlem R. R. Co. in the location of tracks and yards at the Grand Central Station, after which he was principal assistant engineer in the preparation of plans and later in the construction of the Fourth Avenue improvement between the Grand Central Station and Harlem River. In 1874 he was appointed chief engineer of the New York & Harlem River R. R. and superintending engineer of the Fourth Avenue improvement, continuing in the service of the New York & Harlem and New York Central & Hudson River R. R. until 1883, when he was appointed chief engineer of the New York, New Haven & Hartford R. R. Co. On March 10, 1900, he was elected fourth vice-president of the company, and was given general charge of the engineering department, and such other matters as might be referred to him. He assumed the duties of this position May 1, 1900, with headquarters in Boston. In November, 1903, Mr. Curtis was promoted to the position of second vice-president, with headquarters in Boston. Owing to the large amount of engineering work being done by the company between New Haven and New York it was necessary for Mr. Curtis to assume personal charge of this work, and on November 17, 1904, he was transferred to New Haven and Mr. T. E. Byrnes was appointed assistant to the president, with headquarters in Boston. Some of the principal works of Mr. Curtis are: The Fourth Avenue improvement, New York City; the construction of grain elevators, docks, yards, piers, sheds and warehouses for the New York Central & Hudson River R. R. Co. between Fifty-ninth and Seventy-eighth streets, on the Hudson River; the elimination of grade crossings, building of new stations and the four-tracking of the New York, New Haven & Hartford R. R. between New York and New Haven, the double tracking of the line between New Haven and New London, the construction of the station at Providence, the elimination of grade crossings in Westfield, Brockton and Boston, the extension of the Boston & Providence R. R. in Boston to the new terminal station, the construction of the six-track drawbridge over Fort Point Channel in Boston, and the new South Terminal Station, Boston, of which he was consulting engineer.

The following candidates for admission to the American Society of Civil Engineers were elected on Oct. 4: As members: Andrews Allen, contr. engineer, Wisconsin Bridge & Iron Co., Chicago, Ill.; C. L. Allen, Utica, N. Y.; W. R. Armstrong, supt. of construction, Kansas City, Mexico & Orient Ry., Chihauhua, Mexico; T. C. Baily, Washington, D. C.; H. A. Belden, supt. of construction for J. G. White & Co., Inc., Manila, P. I.; L. Bush, chief engineer, D. L. & W. R. R., East Orange, N. J.; C. E. Curtis, civil engineer, Cambria Steel Co., Johnstown, Pa.; W. S. Dawley, engineer maintenance of way, C. & E. I. R. R., Chicago, Ill.; H. A. Dill, engineer and supt. Richmond City Water Works, Richmond, Ind.; E. H. Drury, engineer in charge of construction, Mexican Light & Power Co., City of Mexico, Mexico; Chester Harding, asst. to engineer commissioner of District of Columbia, Washington, D. C.; J. B. Harper, general supt. of irrigation on Indian Reservations, Blackrock, N. Mex.; L. C. Hill, supervising engineer, U. S. Reclamation Service, Roosevelt, Ariz.; W. M. Judd, member of firm, The W. G. Wilkins Co., Pittsburg, Pa.; W. S. Lee, Jr., Charlotte, N. C.; Luis Matamoros, municipal engineer, San Jose, Costa Rica, and chief engineer of Pacific R. R. extension, San Jose, Costa Rica; L. J. Mensch, civil engineer and contractor for re-inforced concrete work, Chicago, Ill.; Frank Neher, principal asst. engineer, maintenance of way, Missouri Pacific Ry. System, St. Louis, Mo.; W. M. Rees, asst. engineer, improving Mississippi River, Memphis, Tenn.; L. E. Ritter, Ritter & Mott, consulting civil engineers, Chicago, Ill.; W. G. Russell, hydrographer, U. S. Geological Survey, Russell, Kan.; R. E. Sheal, with Wellman-Seaver-Morgan Engineering Co., Cleveland, O.; Sakuro Tanabe, professor of civil engineering, Kyoto Imperial University, Kyoto, Japan; A. W. Woodman, civil engineer and agent for the Roebling Construction Co., Boston, Mass. As associate members: Paul Beer, supt. Barber Asphalt Paving Co., Des Moines, Ia.; H. R. Buck, asst. city engineer, Hartford, Conn.; V. H. Cochrane, chief draftsman, Waddell & Hedrick, Kansas City, Mo.; Frederick Davis, asst. engineer, Pennsylvania, New York & Long Island R. R., New York City; L. Dorsey, engineer Elk River Coal & Lumber Association, Clay Court House, W. Va.; Myron S. Falk, instructor in civil engineering, Columbia University, consulting engineer and engineer for Godwin Construction Co., New York City; J. M. Fletcher, Jamaica Government Ry., Albany, Jamaica, B. W. I.; A. L. Giles, supt. Underwriters' Engineering & Construction Co., Sioux City, Ia.; Robert P. Howell, town engineer, Phillipsburg, N. J.; C. A. Hunt, asst. engineer, Rapid Transit R. R. Commission, New York City; Torao Kawaguchi, Kumamoto, Japan, M. O. Leighton, U. S. Geological Survey, Washington, D. C.; Kieffer Lindsey, asst. engineer department of state engineers and surveyors, Syracuse, N. Y.; G. S. Meek, civil engineer for Pittsburg & Conneaut Dock Co., Conneaut, O.; Clifford Older, asst. engineer, Chicago & Alton Ry., Slater, Mo.; Clyde Potts, with Williams & Whitman, Inc., New York City; R. F. Proctor, with Williams & Whitman, Inc., New York City; J. C. Riedel, Brooklyn, N. Y.; F. H. Shaw, chief engineer to special sewerage commision, Lancaster, Pa.; S. F. Stokes, district engineer, Public Works Department, Transvaal, Standerton, South Africa; W. A. Thompson, principal asst. city engineer, East St. Louis, Ill.; C. D. Thurber, asst. civil engineer, U. S. Navy, Norfolk, Va.; B. H. Upjohn, engineer for Eidlitz & McKenzie, architects, New York City; F. C. Waddell, with Milliken Bros., New York City; E. C. Woodward, asst.

engineer, Reclamation Service, U. S. Geological Survey. The following asociate members were announced transferred to the grade of member by the Board of Direction: E. H. Baldwin, Alcova, Wyo.; G. L. Christian, New York City; G. A. Gessner, Jr., Toledo, O., H. C. Humphrey, Lucena Tayabas Province, P. I.; F. P. McKibben, Boston, Mass.

TRADE PUBLICATIONS.

The latest publications of the General Electric Co. include additions to its flyers and bulletins and an important special book. The flyers are No. 2,163, standard key and keyless sockets; No. 2,164, concentric diffuser for incandescent lamps; No. 2,165, electrolier key and keyless sockets. The additions to the bulletins are: No. 4,417, generating station and sub-station switchboards for continuous current railway systems operated from three-phase generators; No. 4,418, the synchronism indicator; No. 4,419, new General Electric high-efficiency high candle-power incandescent units; No. 4,420, the Thomson high torque induction test meter of type B. The new book is entitled "Electricity versus Steam for Train Haulage." It opens with a paper on recent developments in electric traction, read before the New York Railroad Club by Mr. W. B. Potter last winter, which is followed by an article from the "Street Railway Journal," giving the results of comparative speed tests of steam and electric locomotives on the New York Central R. R., and a paper by Mr. L. R. Pomeroy on the electrification of trunk lines. This profusely illustrated book gives a large amount of definite information concerning the use of electricity in heavy traction, and is particularly adapted for railway officials who wish to examine the latest data on the subject.

The Ingersoll-Sergeant Drill Co., New York, has issued a very attractive little "blue-book" of air compressors. It is not a trade list, but merely a well written and well published description of the leading features and special fields of the great variety of air-compressing apparatus made by this company.

The Sprague Electric Co., 527 West 34th St., New York, has lately developed a line of motors specially for crane service. These are known as type N and are described in the company's bulletin 223. The requirements of crane service are explained, and the details of the motors designed to meet them are illustrated.

The Krupp tube mills for dry grinding are described in a pamphlet lately prepared by Thos. Prosser & Son, 15 Gold St., New York, American representatives of the Krupp works. The standard size of these mills is 5 ft. diameter and 22 ft. length or 6 ft. diameter and 16 ft. length, but other sizes are made if desired. The company has an experimental station where it will conduct tests of methods of dressing and crushing materials for those contemplating the purchase of Krupp apparatus.

Two folders of unusual interest have recently been issued by the Jeffrey Mfg. Co., Columbus, O. The first describes the company's line of roll crushers for breaking up coal, the swing hammer crusher, and the pulverizer and air separator, a line of apparatus designed to reduce coal to any desired size short of impalpable powder. The second folder illustrates a number of portable outfits for excavating and screening sand and gravel. They consist of a ladder dredge mounted on a timber frame and raising the material to screens where it is separated into two sizes and shot into cars or hoppers. The apparatus can be mounted on an ordinary flat car, and affords an easy and cheap method of securing sand and gravel.

The Power Specialty Co., Trinity Bldg., New York, has issued a new edition of its valuable book on superheated steam. It explains the construction of the Foster apparatus, illustrates its application to a number of types of boiler as well as its independent pattern, and gives tables of the carrying capacity of extra heavy steam pipe and the properties of saturated steam.

The Crocker-Wheeler Co., Ampere, N. J., has issued a new bulletin relating to railway generators. The company is now making a complete line of such machines from the largest to the smallest required to furnish direct-current for railway purposes, and this book contains a well-illustrated description of their characteristic details and a table of the main dimensions of those sizes which may be called standard.

An album of excellent views of stacks built by the Weber Steel-Concrete Chimney Co., Chicago, has been published by that company. It gives a brief description of the construction and advantages of reinforced concrete for such structures, but is mainly a collection of engravings of stacks built in different parts of the country. Some of these are of very large size, that recently completed at Tacoma being 300 ft. high and 18 ft. in diameter inside, while one is now being erected at Butte which will be 350 ft. high and of the same diameter.

The improved Cincinnati air compressor is described in a special bulletin issued by the Laidlaw-Dunn-Gordon Co., New York. Its special feature is a new gear for the air valves, which mechanically and positively controls the opening of the suction, the closing of the suction and the closing of the discharge. The design and advantages of this gear, and of the other details of the compressors, are fully described and illustrated.

An album recently issued by Julian Kennedy, Sahlin & Co., Ltd., of Pittsburg, London and Paris, describes some of the work of the members of this firm in Europe and America in the last twenty-five years. These include blast furnaces, Bessemer and open hearth steel plants, engines, gas producers, steel mills of many types, steam hammers and industrial plants of large size. The list of plants numbers nearly 150, of an aggregate value of $50,000,000.

The development of vitrified pipe of large diameter is told in an interesting manner in a pamphlet issued by The Blackmer & Post Pipe Co., St. Louis. This was begun about 1900 with 30-in. pipe, and as the difficulties of manufacture were surmounted other large sizes were produced. Tests of these large pipes, under both crushing and bursting pressures, suggestions for handling them, and reports from engineers who have used them, add to the value of the book.

An album of handsome plans and views of industrial establishments has been issued by the McClintic-Marshall Construction Co., Pittsburg, to illustrate its facilities for rapidly erecting structural steel work and some of the plants for which it has been the contractor. The company's works at Rankin and Pottstown have a capacity of 7,000 tons of finished work per month and employ about 2,500 men in the shops and field when running full. The Rankin plant, built in 1901, is particularly interesting from its arrangement and tools. The buildings illustrated as examples of the company's work are machine shops and foundries of railway and manufacturing corporations.

The air compressors built at the Franklin works of the Chicago Pneumatic Tool Co. are the subject of a 72-page book just published. This explains their design in very full detail, gives lists of the many types of steam and belt driven compressor made by the company, and unusually complete directions for erecting and operating such machines. There are also a number of tables of assistance in designing plants using compressed air.

The Thos. H. Dallett Co., of Philadelphia, has now been making portable drilling machinery for twenty-two years, and the tools described in its new catalogue have accordingly no untried features. It is much easier to take a tool to a heavy forging or casting than to take the latter to the tool, but portable drills and boring machines for such work have to be specially designed. Lately it has been found that such tools are unexpectedly handy in structural steel shops for pieces not duplicated often enough to warrant an outlay for jigs. The catalogue shows many varieties of belt and electrically driven drills for general work and several designed specially for boiler shops.

The Christensen air brake is not a novelty, over 15,000 of them being now in use on electric railways, but parties interested in such equipment will find much valuable information concerning it in bulletin 357 of the of the National Electric Co., Milwaukee. The very compact electrically driven air compressor employed with these brakes ought to be useful for many other purposes. Bulletin 355 of the same company describes its belt-driven generators, built in sizes of 50 to 500 kw. and conforming with the standards of the Am. Inst. E. E. The design of the details is explained and there are a number of tables of the leading dimensions of machines of different ratings.

Westinghouse railway apparatus is described in a general way in a handsome pamphlet prepared specially for the convention of the American Street Railway Association. It is particularly interesting as a concise statement of those features of its products which the Westinghouse Electric & Mfg. Co. considers most important. The company has also issued two new circulars, No. 1120 describing the 113 railway motor of 200 nominal horsepower and No. 1123 describing a new line of prepayment wattmeters.

A necessary feature of any municipal office entrusted with the supervision of the service of private electric companies is a set of standardized instruments. Until recently it was impracticable to secure them save at great expense by importation, but recently the Electrical Testing Laboratories have been established at 550 East 80th St., New York, to inspect and accurately test such apparatus of any make. A full description of the equipment and methods used in such works is given in a pamphlet just issued.

In the course of its own manufacturing work the Buffalo Forge Co., Buffalo, N. Y., has developed a line of independent punches and continuous shears for sheet metal. For about a year these have been sold to the blacksmith trade, but the increased demand for them from metal working shops generally has led the company to make the tools one of its standard lines. The new catalogue in which they are described states that they are made of armor plate steel in order to withstand the heavy and irregular strains coming upon them. They are made in a great variety of styles, from hand punches up to machines capable of handling ½-in. plate.

The Crane Co., Chicago, has issued an advance circular concerning a new Cranelap extra-heavy flanged pipe joint, which it has designed for working pressures up to 250 lb. These are made with the flanges of cast iron, ferro-steel, malleable iron, cast steel or weldless steel, as desired, the pipe being simply expanded back against the face of the flange. The new Craneweld joint with wrought steel flanges welded to the pipe is described in another circular, which gives full dimensions of the various shapes in which the flanges are finisned.

The Pittsburg Filter Mfg. Co., Farmers' Bank Build-Pittsburg, has recently published a number of pamphlets of more than usual value. The first of these is a general description of the processes of mechanical filtration and water-softening. Open and pressure filters are explained and there are a number of tables of standard sizes of such apparatus. The second book explains water softening and illustrates a large number of plants built by the company, including the huge installation for the Tennessee Coal, Iron & Railway Co., at Ensley. The third pamphlet is a discussion of mechanical filters and city water supplies. It explains the process involved and describes the apparatus built for the purpose by the company. Illustrations of a number of such plants are given. The fourth book is a report on bacterial examinations of the raw water and effluent of the mechanical filters at Danville, Va. These tests were made by Dr. Ernest C. Levy, director of the municipal water laboratory at Richmond.

A tasteful little folder on the cause and prevention of rust, has just been issued by the Detroit Graphite Mfg. Co. It states that the Superior graphite paint, six years old, on the Union Trust Bldg. in Baltimore, was in perfect condition and adhering firmly to the metal, which showed no rust, after the structure had passed through the great fire.

The General Electric Co.'s Publication Bureau at Schenectady has recently issued many new publications. The new bulletins are: No. 4412, electric hoists for building operations and general construction work; No. 4413, the CQ motors of ¼ to 20 hp. for machine shops; No. 4416, service cut-outs for three-wire installations; No. 4415, type C of the Thomson recording wattmeter; No. 4414, electrically driven turbine house pumps. The increasing use of electrical apparatus in the household is indicated by folders on coffee-making percolaters and flatirons heated electrically. The new flyers are: 2146, single-pole snap switch; 2153, candelabra adapter; 2154, 15-ampere, 125-volt, double-pole knife switch; 2155, type SF speed-controlling rheostats; 2156, ceiling rosette with enclosed fuse; 2157, combined switch and enclosed fuse cut-out for car lighting; 2158, combination service switch and cut-out in iron box; 2159, enclosed fuse cut-outs; 2160, Edison sockets rings; 2161, porcelain ceiling boards; 2162, pendant switches.

The De La Vergne Machine Co., New York, has published, on heavy cardboard, a table of the properties of saturated steam. It gives the temperature, total heat units, heat of vaporization, density, volume, weight and factor of equivalent evaporation from and at 212° for gauge pressures at 5 lb. intervals from 0 to 300 lb.

The Morris Machine Works, Baldwinsville, N. Y., has issued an abridged catalogue of centrifugal pumping machinery containing condensed tables and descriptions of standard types of such apparatus. The relative advantages of vertical and horizontal types are explained, the important differences in various styles are pointed out, suggestions for selecting the right pump for a given purpose are made, and there are very good directions for erecting and running these equipments. One of the outfits illustrated is a compact direct-driven unit boiler, all on a four-wheel truck so as to be available for draining cellars, pumping out excavations and similar purposes where a permanent plant is not required.

One of the new companies organized to carry on reinforced concrete construction is the Underwriters Engineering & Construction Co., 34 West 26th St., New York. In a book just issued to explain its objects, the company states that it will undertake the design and construction of reinforced concrete structures on the basis of cost-plus-a-fixed-sum, and that it will make a specialty of rapid work. Prof. Lewis J. Johnson, designer of the Harvard Stadium, is consulting engineer of the company; Prof. Charles L. Norton will pass on all questions of fire-resistance, and Mr. Frank B. Gilbreth will direct the construction. All these relations and purposes are explained in detail in the pamphlet.

The David Bell Engineering Works, Buffalo, N. Y., has issued a bulletin describing its line of single-frame, standard-guide steam hammers with reinforced guides and stiffened column. These are built in sizes having falling weights of 300 to 2,500 lb. It has lately sold three of them to the Isthmian Canal Commission for use at Panama, and others have been sent recently to the Navy Yards at Boston, New Orleans and Mare's Island. The frames of these hammers have lately been greatly strengthened at points where the heaviest strain comes.

CONTRACTING NEWS

OF SPECIAL INTEREST TO
CONTRACTORS, BUILDERS, ENGINEERS AND MANUFACTURERS
OF ENGINEERING AND BUILDING SUPPLIES.

WATER.

Notes Arranged Alphabetically by States.

Osceola, Ark.—J. H. Lovewell, City Clk., writes that C. H. Gaylord, W. J. Driver and L. A. Morris are the committee for the proposed water works; probable cost, $20,000.

Los Angeles, Cal.—Bids will be received by the Bd. of Water Comrs. until Oct. 16 for furnishing and delivering, f. o. b. cars at Los Angeles, approximately 5,050 tons c. i. water pipe, as advertised in The Engineering Record.

Lompoc, Cal.—The Lompoc Valley Water Co., is reported to be considering the question of installing a pumping plant and a ditch on the south side of the valley.

Trinidad, Colo.—Bonds to the amount of $200,000 are reported sold to be used for the purpose of extending the water mains to North Fork and building a reservoir in that vicinity. The pipe line will be about 40 miles in length.

**Idaho Springs, Colo.*—Chas. Brandstetter, City Clk., writes that the contract for improving and extending water works (bids opened Aug. 21) has been awarded to the Boulder Iron Wks., of Boulder, for $40,037.

Decatur, Ga.—The citizens of this place are reported to be discussing the question of constructing water works.

Nampa, Idaho.—Bids will be received until Nov. 1 by the Nampa & Meridian Irrigation Dist. (Hugh E. McElroy, Secy., Sonna Blk., Boise), for the purchase of $285,000 bonds to be used in payment for the existing works. This district was organized in 1904 and embraces all lands under the Ridenbaugh canal system in Ada and Canyon counties. Its purpose was the purchase and enlargement of said canal system. Plans have been prepared which call for a bond issue in all of $583,505. Of this amount $285,000 is to be used for the payment of existing works, the remainder to be used for enlarging the canal, constructing a reservoir, etc.

Minooka, Ill.—Bids will be received until Oct. 20 by the Village Bd. for a water system. M. L. Kaffer, Village Clk.

Huntingburg, Ind.—Aug. F. Becker, City Clk., writes that no bids were filed on Oct. 2 for the construction of an intake for the new water works lake, but by resolution the water wks. Com. has been authorized to have the intake constructed and completed.

Madrid, Ia.—Water works bonds to the amount of $14,000 are reported sold. It is stated that as soon as a suitable water supply is secured the contract for laying water mains will be let.

Covington, Ky.—The Superintendents of Water Works of Covington and Newport will prepare plans for the construction of an emergency water main connecting the water works of both cities.

Williamsburg, Ky.—See "Power Plants, Gas and Electricity."

Yarmouth, Me.—C. L. Bucknam, Chmn. Bd. Selectmen, writes that bids will be opened at 2 P. M. on Oct. 7 for the proposed water works extensions; probable cost, $25,000.

Oxford, Mass.—Byron Clark, Clk. Oxford Water Co., writes that it is proposed to construct water works, at a cost of $60,000.

Grand Rapids, Mich.—Bids will be received by the Bd. of Pub. Wks. until Oct. 13 for constructing a standpipe or elevated tank of concrete-steel, 80 ft. high and 50 ft. diam., for the water works, as advertised in The Engineering Record.

Rochester, Mich.—Bids will be received until Oct. 9 by the Common Council, for constructing a 2,000,000-gal. reservoir at the water works. W. J. Taylor, Village Clk.

**Boyd, Minn.*—The following are the bids opened on Sept. 26 for the construction of water works (a) gravity system, (b) compressed air system, (Oscar Claussen, Engr., St. Paul): Allan Black & Co., of St. Paul, *a* $8,600, *b* (2 bids) $8,798 and $8,510; Dwyer Plumbing & H'ting Co., of St. Paul, *a* $8,754, *b* $8,900; H. J. Bernier, of St. Paul, *b* (2 bids) $6,475 and $6,350; W. D. Lovell, of Minneapolis, *a* $9,000, *b* (2 bids) $8,950 and $8,600; Des Moines Bridge & Iron Wks., of Des Moines, Ia., *a* $8,725, *b* (2 bids) $9,150 and $8,600; J. L. White, Sioux Falls, S. D., *a* $7,200, *b* (2 bids) $6,190 and $5,700 (awarded contract).

**Montgomery, Minn.*—The Chicago Bridge & Iron Wks., of Chicago, Ill., is stated to have secured the contract for a steel tower and tank for the water works (bids opened Sept. 16) for $4,200.

Crookston, Minn.—A. M. Childs, City Clk., writes that it is not proposed to construct new water works here, as previously reported.

Missoula, Mont.—The Blodgett Creek Reservoir Co. is reported incorporated by H. S. Page, Henry Grover and Jas. Dunbar to build a reservoir to cover 1,000 acres of land and be 30 ft. deep, for irrigation purposes. The water will be taken from Blodgett Creek and one of the small lakes on the mountain to the north of the said creek.

Helena, Mont.—Two companies are reported to have been incorporated at Helena on Sept. 26 for irrigation purposes namely: the Woodside Co., capital, $6,000. Incorporators: W. S. Burrell and W. H. Price; and the Blodgett Creek Reservoir Co., capital, $10,000. Incorporators: H. S. Page, Jas. Dunbar and Henry Grover.

Auburn, N. Y.—The Bd. of Water Comrs. is stated to have decided to build a new intake pipe 2,900 ft. out into Owasco Lake.

Waynesville, N. C.—It is stated that bids will be received until Oct. 14 by the Mayor and Bd. of Aldermen for furnishing material and laying 2,250 lin. ft. 4-in., 300 ft. 2-in. and 750 ft. 1-in. water main, and 3 Glaymorgan fire hydrants. C. G. Logan, Supt. Water Wks.

Fayetteville, N. C.—Press reports state that bids will be received until Oct. 10 by Mayor C. B. McMillan for $100,000 water works bonds.

Lexington, N. C.—The citizens are reported to have voted Sept. 26 to issue $40,000 bonds for water, sewers, street improvements, etc.

Perrysburg, O.—Bids will be received until Oct. 18 by the Bd. Trus. of Pub. Affairs (R. R. Hartshorn, Clk.), for furnishing material and erecting on foundation to be prepared by the Bd. a 40,000-gal. steel tank on steel tower; also 92.4 tons 4-in., 125.4 tons, 6-in., 53.5 tons 8-in., and 6 tons 10-in. pipe, 3,500 lbs. special castings, 23 fire hydrants and 50 valves, delivered f. o. b. cars, Perrysburg. Riggs & Sherman, Engrs., 613 Nasby Bldg., Toledo.

Milton, O.—Press reports state that bids will be received until Oct. 14 by John Coape, Village Clk., for $2,000 water works bonds.

Cincinnati, O.—The plans of G. H. Benzenberg, Acting Ch. Engr. of the Bd. of Water Comrs., for the filtration plant, are stated to have been approved by the State Bd. of Health. He estimates the cost for completing the filters, basins and reservoirs at $539,000, and the cost of manufacturing and furnishing steel pipe and settling reservoirs at $39,000.

Malta, O.—W. S. Connor, Village Clk., writes that the citizens voted Sept. 22 to construct water works. No engineer selected as yet.

**Lancaster, O.*—Geo. Cunningham, Clk. Bd. Pub. Service, writes that the contract for 3,170 ft. 4-in. water line extension (bids opened Sept. 26) has been awarded to Jos. L. Work, of Lancaster, for $1,766.

Hood River, Ore.—It is reported that bids will be received by J. H. Shoemaker, Secy. Hood River Irrigation Dist., at Wasco, until Oct. 28 for the construction of the necessary canals and works.

Independence, Ore.—G. N. Miller, of Dallas, Ore., is reported to have been selected by Council to estimate the cost of a gravity water system.

Panama.—Bids will be received until Oct. 13 by the Isthmian Canal Comn. (D. W. Ross, Purchasing Agent) Washington, D. C., for furnishing 3 steel water towers and 6 earth spreaders; also Oct. 16 for furnishing steam pumps, boilers, manifolds for air drills, wrought, cast and black iron pipe and pipe fittings, lead pipe and fittings, brass and iron valves; steel floor beams, etc.

Altoona, Pa.—Harvey Linton, City Engr., writes with regard to increasing the water supply that ordinance No. 1621, confirming the appropriation of waters of Scotch Knob Run by the Bd. of Water Comrs., has passed second reading in Council Ordinance No. 1623, has passed third reading in Council, ratifying, approving, adopting and confirming the appropriation of the waters of Riggles Gap Run made by the Water Comrs. Engineer, C. W. Knight, of Rome, N. Y.

Harrisburg, Pa.—Bids are wanted by Mason D. Pratt, Engr., 18 N. 3d St., Harrisburg, for the construction of a 5-ft. tunnel and the laying of a 36-in. c.-i. pipe in bed of Susquehanna River at Harrisburg, as advertised in The Engineering Record.

Philadelphia, Pa.—Major Gillette is reported to have submitted to Mayor Weaver a report on increasing the supply of filtered water of Chestnut Hill, Mt. Airy, Germantown, Roxborough and Manayunk. He suggests increasing the pumping capacity at Shawmont by at least 12,000,000 gal. per day.

The following are reported to be the bids opened on Oct. 3 by A. Lincoln Acker, Dir. Dept. Pub. Wks., for pumping out Torresdale conduit: (*a*) pumping out the water to a plane a foot above the bottom of the conduit, including leakage of all water entering conduit at a rate of not more than 1200 gals. a minute, and the installation of a mine elevator, etc.; (*b*) maintenance and operation of pumps; (*c*) cost of pumping water that leaks in at more than 1,200 gals. a minute: D'Ollier Eng. Co., *a* $12,700, *b* $120, *c* $25; J. E. McMenamy, *a* $18,-

Danbury, Conn.—A. L. Davis, City Engr., writes that the following are the bids opened on Sept. 25 for furnishing material and constructing a reservoir dam, forebay and pipe line; (*a*) W. J. Flannigan, Katonah, N. Y.; (*b*) Ford & Waldo, New York, N. Y.; (*c*) Gannung & Hoyt, Katonah, N. Y.; (*d*) Peter Sweeney, Danbury:

	a	*b*	*c*	*d*
26,000 cu. yd. earth emb'km't, dam	$0.65	$0.68	$0.70	$0.68
2,500 cu. yd. stripping, dam site	.35	.40	.30	.45
200 cu. yd. rock	2.50	2.00	2.75	1.85
2,200 sq. yd. paving	.50	1.35	1.25	.62
100 cu. yd. concrete, dam	6.00	10.00	7.00	7.65
180 cu. yd. concrete, gate house (lump sum)	5,000.00	5,310.00	5,070.00	3,300.00
30,000 cu. yd. earth emb'km't, forebay	.45	.68	.70	.58
13,000 cu. yd. stripping, forebay	.35	.40	.30	.36
600 cu. yd. concrete, entrance and exit chambers (lump sum)	8,500.00	11,400.00	9,800.00	7,392.00
600 cu. yd. stripping, spillway	.35	.40	.30	.45
6,300 lin. ft. 30-in. wooden stave pipe	2.50	3.50	4.65	2.55
8,300 lin. ft. 24-in. c. i. pipe	5.50	5.50	5.65	4.15
Totals	$113,260	$134,175	$140,110	$105,531

Gunnison, Colo.—The following are the bids opened on Sept. 26 at the office of the U. S. Reclamation Service, Montrose, for the completion of Gunnison Tunnel, for the diversion of water from Gunnison River to Uncompahgre Valley, Colo.; (*a*) J. G. White & Co., 43 Exchange Place, New York, N. Y.; (*b*) John McKechney, 288 E. Ohio St., Chicago, Ill.; (*c*) A. J. Raisch, 26 Montgomery St., San Francisco, Cal.:

	a	*b*	*c*
Tunnel—			
Class 1, 11,500 lin. ft.	$48.50	$56.00	$65.00
Class 2, 1,200 lin. ft.	52.00	59.00	75.00
Class 3, 10,000 lin. ft.	62.75	53.59	85.00
Class 4, 3,500 lin. ft.	61.00	72.74	95.00
Lining with concrete portion of tunnel already excavated—			
Class 1, 1,500 lin. ft.	9.00	4.00	12.00
Class 2, 100 lin. ft.	11.50	7.00	17.00
Class 3, 1,400 lin. ft.	12.50	13.68	17.00
Class 4, 1,400 lin. ft.	17.00	14.91	17.00
Excavation for enlarging tunnel section—			
Classes 1 and 2, 3,000 cu. yd.	8.00	7.00	12.00
	$1,541,100	$1,573,016	$2,123,300

Cincinnati, O.—The following are the bids opened on Sept. 29 by the Bd. of Trus. Comrs. of Water Wks., for the construction of filters, coagulation basins and clear water reservoir, with pipe lines, valve chambers and miscellaneous work in connection therewith: (*a*) Keeling & Ridge, Cincinnati; (*b*) F. H. Kirchner, Cincinnati; (*c*) W. J. Gawne Co., Cleveland; (*d*) Ferro-Concrete Constr. Co., Cincinnati; (*e*) Pittsburg Filter Mfg. Co., Pittsburg, Pa.:

	a	*b*	*c*	*d*	*e*
Clearing and grubbing (lump sum)	$1,000.00	$1,500.00	$1,000.00	$1,500.00	$3,600.00
49,000 cu. yd. general excavation	.40	.48	.60	.52	.64
47,000 cu. yd. selected clay material, excav. and placing	.45	.55	.80	.60	.81
25,000 ton-miles compacting fills	.20	.15	.30	.20	.23
Laying cast-iron pipe—					
3,500 lin. ft. 60-in.	5.00	5.00	7.00	6.30	7.36
825 lin. ft. 36-in.	2.50	3.50	5.00	4.20	5.16
215 lin. ft. 30-in.	2.50	2.90	4.00	3.50	4.77
380 lin. ft. 24-in. (overflow)	2.00	2.90	2.00	3.00	3.87
425 lin. ft. 24-in. (drain)	2.00	2.90	3.00	2.50	3.98
560 lin. ft. 20-in.	1.50	1.50	2.00	2.00	2.76
95 lin. ft. 12-in. (from chamber G)	2.50	1.25	5.00	2.50	3.71
1,130 lin. ft. 12-in. (line parallel to filter house)	.75	1.25	1.00	1.75	2.91
2,000 lin. ft. 8-in.	.50	1.00	.30	1.00	.43
175 lin. ft. 6-in.	.50	.60	.50	1.00	.35
90 lin. ft. 4-in.	.50	.60	.50	1.00	.35
Furnish and lay 4-in. wrought-iron pipe and hose connection (lump sum)	250.00	4,000.00	200.00	400.00	255.00
1,555 lin. ft. 84-in. steel pipe, laying	6.00	8.00	7.00	7.00	6.82
Setting valves—					
8 60-in. gate valves	100.00	150.00	100.00	100.00	40.00
1 48-in. gate valve	75.00	125.00	100.00	70.00	40.00
11 84-in. sluice valves	75.00	175.00	100.00	80.00	50.00
2 60-in. sluice valves	75.00	150.00	75.00	70.00	50.00
6 mud valves	100.00	150.00	75.00	100.00	50.00
1,950 cu. yd. broken stone revetment	1.75	2.00	1.50	2.00	2.50
150 cu. yd. dry stone paving	7.00	5.00	6.00	7.00	4.50
360 cu. yd. brick masonry	15.00	16.00	17.00	12.00	14.00
5,500 cu. yd. concrete, Class A (dividing wall)	5.50	7.00	6.50	6.00	6.47
22,000 cu. yd. concrete, Class B (general)	8.00	7.00	7.75	8.40	8.16
500 cu. yd. concrete, Class C (floors)	15.00	18.00	14.00	18.00	18.46
4,330 cu. yd. concrete, Class D (filters)	10.00	10.00	7.50	11.00	9.76
530 cu. yd. concrete, Class E (curbs)	8.00	12.00	10.00	9.00	15.00
220 tons steel reinforcement	80.00	80.00	75.00	65.00	80.00
26,800 sq. yd. asphalt, burlap and brick revetment	1.25	1.45	1.35	1.30	1.60
13,300 sq. yd. asphalt waterproofing	.50	.60	.50	.50	.65
Placing filter piping (lump sum)	25,000.00	42,000.00	30,000.00	24,000.00	13,706.00
28 filter strainer systems, placing	500.00	453.00	200.00	420.00	125.00
600 cu. yd. filter gravel, placing	1.00	1.00	1.00	2.00	.75
4,000 cu. yd. filter sand, placing	.75	.75	.40	.85	.50
8 tons wrought-iron and steel work, furnish and place	140.00	80.00	150.00	150.00	160.00
14 tons iron castings, furnish and place	120.00	60.00	100.00	120.00	100.00
10 tons miscellaneous castings, placing	20.00	10.00	40.00	25.00	40.00
Total	$464,050	$487,566	$488,112	$510,025	$514,885

**Items marked thus give the names of parties awarded contracts.*

694, *b* $230, *c* $200; Pneumatic Eng. Co., *a* $19,875, *b* $55, *c* $7; Chas. Crowley, *a* $19,900, *b* $86, *c* $110; Sweigart & Co., *a* $31,400, *b* $150, *c* $75.

Two bids were received same time and place for replacing sand in Belmont and Roxborough plants: Wm. McKeon bid 29¼ cts. per cu. yd. for Belmont, 30 cts. for Upper Roxborough and 30 cts. for Lower Roxborough. Williamson & McLaughlin, $1584, lump sum, for Belmont sand, $340 for Upper Roxborough sand and $663 for sand for Lower Roxborough.

Santa Anna, Tex.—See "Power Plants, Gas and Electricity."

El Campo, Tex.—B. W. Ludeman, of El Campo, one of the directors of the Illinois-Indiana Irrigation Co., writes that the company proposes constructing an irrigation system about eight miles north of El Campo, at a probable cost of $50,000. Bids will probably be received about Jan. 1. F. M. Bullock, of Glen Flora, Tex., and S. L. Hurlbut, of El Campo, are also interested. No engineer as yet.

**Galveston, Tex.*—A. M. Lockett & Co., of New Orleans, La., are stated to have secured the contract for constructing a pumping station at Alta Loma to increase the water supply of Galveston (bids opened Sept. 21), for $15,484.

Charlottesville, Va.—The citizens are reported to have voted to issue $135,000 bonds for extending the municipal water supply.

Burlington, Vt.—F. O. Sinclair, City Engr., writes that the city contemplates installing a filter, but no definite steps have yet been taken.

Tacoma, Wash.—The Council on Sept. 27 is stated to have passed the resolution authorizing the Comr. of Pub. Wks. to have plans and specifications prepared for a new pumping station.

Vancouver Barracks, Wash.—The following are the bids opened on Sept. 28 by the Constructing Q. M. (C. E. Earl, Clk.) for a reinforced concrete water tank of 100,000 gal. capacity: Concrete Constr. Co., 701 Chamber of Commerce, Portland, Ore., $3,660, with concrete roof, and $3,450 with wooden roof; J. D. Tresham, 972 E. Taylor St., Portland, Ore., $6,583; K. G. Lundstrom, 302 Commercial Bldg., Portland, Ore., $3,200, and the Contracting Eng. Co., Fenton Bldg., Portland, Ore. (3 bids), designs, A, B and C, $2,550, $2,500 and $2,550, respectively.

Rosalia, Wash.—Prof. W. J. Roberts, of Pullmer, has rendered a preliminary report on a proposed new system of water works for Rosalia, to cost $17,000. F. C. Chekal, Town Clk.

Walla Walla, Wash.—Engineer Thomson, of Seattle, who was employed by Council to investigate sources of supply for a gravity water system, is stated to have filed his report, in which he recommends that further efforts to develop an underground system on Thomas or Harbert ranch be abandoned and that the city take its supply directly from Mill Creek at a point 13¼ miles from Walla Walla, just this side of the Oregon line; the use of a 20-in. bbl.-stave pipe is recommended; total cost, without reservoirs, is placed at $246,000. A bond issue of $235,000 is recommended, the balance to be taken from the water revenues. It is stated that the matter of issuing bonds will probably soon be submitted to the voters.

Port Washington, Wis.—See "Power Plants, Gas and Electricity."

Port Dalhousie, Ont.—The question of constructing water works at a cost of $30,000 is reported under consideration here.

Toronto, Ont.—The bid of the Canadian Westinghouse Co. for the new high-pressure engines at $68,411 is reported to have been recommended for acceptance.

SEWERAGE AND SEWAGE DISPOSAL.

Notes Arranged Alphabetically by States.

Ft. Miley, Cal.—Bids will be received until Oct. 21 by Col. Wm. S. Patten, Q. M. G., San Francisco, for reconstructing sewer outfall at Ft. Miley.

Fresno, Cal.—The City Trus. are reported to have accepted the plans of the City Engineer for a new sewerage system, to cost about $175,000.

Denver, Colo.—We are informed that plans are in preparation for the construction of the North Side Storm Sewer District. Date of receiving bids not yet set.

**Washington, D. C.*—The contract for two sluice gates, 60 in. in diam., at the sewage pumping station (bids opened Sept. 25) has been awarded to Cattin Valve Co., Neponset, Boston, Mass. D. E. McComb, Engr. of Sewers.

Local press reports state that D. E. McComb, Supt. of Sewers, has submitted to the Dist. Comrs. estimates for sewers for the next fiscal year as follows: For cleaning and repairing sewers and basins, $38,000; for main and pipe sewers and receiving basins, $45,000; for suburban sewers, $44,000; sewage disposal project, dykes, $73,000; sewage pumping station, $63,588; Arizona Ave. sewer system, $50,000; Ivy City trunk sewer, $50,000; trunk line sewers in California Ave. and in valley parallel with and east of Wisconsin Ave. and the Naval Observatory, $70,000; intercepting sewer along west side of Rock Creek bet. P St. and Military Road, $298,100; sewer in valley of Broad branch and Soapstone branch, $28,800; sewer in valley of Falls branch, $100,550; extension of east side intercepting sewer from boundary sewer to Brookland, $342,000.

Lake City, Fla.—J. C. Sheffield, Chmn. Bd. Trus., writes that bids will be received on Oct. 20 for the purchase of $40,000 bonds of which $25,000 is for the proposed sewerage system and the remainder of street improvements.

Grangeville, Idaho.—Prof. W. J. Roberts, of Pullman, has made the surveys and is preparing plans for a complete sewerage system for Grangeville. Population, 2,200. Geo. M. Robertson, Mayor.

Rockford, Ill.—Bids will be received at the office of the President of the Bd. of Local Improv. until Oct. 11 for constructing sewers in portions of Elm and 7th Sts. and 7th Ave., as advertised in The Engineering Record; estimated cost, $6,940.

Marion, Ind.—It is reported that bids will soon be asked by the Bd. of Pub. Wks. for the construction of a combined main trunk sewer in E. 3d and Flynn Sts.

Portland, Ind.—Plans and specifications are reported as being prepared for the construction of a trunk sewer in the east end of the city.

Rockport, Ind.—Robt. Atkinson, Town Clk., writes that bids will probably be received in November for the construction of a sewerage system; probable cost, $5,000. Engineer, J. E. Peckinpaugh.

Ames, Ia.—The following are the bids opened Sept. 25 for 2,690 ft. of 10-in. sewer pipe and 14,980 ft. of 8-in., with 6-in. sub-drains, manholes, lampholes, etc.: R. C. De La Hunt, Cedar Rapids, $19,557; Des Moines Bridge & Iron Wks., Des Moines, $21,976; W. F. Cook, Des Moines, $22,340; King-Lambert Co., Des Moines, $23,323; W. A. Edgar, Cedar Rapids, $23,920; Jas. Horrabin & Co., Des Moines, $24,129; W. C. Ferguson, Batavia, Ia., $24,655, and O. P. Herrick, Des Moines, $26,645. Engineer, A. Marston, of Ames.

Winfield, Kan.—The question of constructing a sewerage system is reported under consideration here.

Brockton, Mass.—The City Council has appropriated $20,000 for highways and $10,000 for surface drainage, all to be done by city labor. No contracts except for material. Chas. R. Felton, City Engr.

Boston, Mass.—The Common Council on Sept. 29 passed the loan order of $600,000 for the construction and extension of the sewerage system.

Belding, Mich.—Bids will be received by Wm. E. Fisher, City Clk., until Oct. 23 for furnishing all material (except pipe) and building complete main sewers in Washington, Liberty and Broas Sts., as advertised in The Engineering Record.

Moorhead, Minn.—Bids are wanted Oct. 16 for the construction of a main outfall sewer. H. E. Roberts, City Clk.; Oscar Claussen, Consulting Engr., Natl. German-American Bank Bldg., St. Paul.

Albert Lea, Minn.—Wm. Barneck, City Engr., writes that the citizens voted Sept. 26 to construct a sewer from Spring Lake through Gilbert House Hill to Shell Rock River; cost reported to be $18,000.

**Kansas City, Mo.*—The R. J. Boyd Constr. Co., Heist Bldg., is reported to have secured a contract on Sept. 28 for constructing a sewer on 38th St. and Euclid Ave., for $21,175.

**St. Louis, Mo.*—John F. McMahon is stated to have secured the contract for constructing the 13th St. sewer (bids opened Sept. 15) for $36,860.

**Dover, N. H.*—Wm. A. Grover, City Engr., writes that Michael McCone, of Dover, has secured the contract for constructing a sewer (bids opened Sept. 28) at 69¼ cts. per lin. ft. for 1,992 ft. 10 and 12-in. pipe; $3.93 per cu. yd. for 227 cu. yd. ledge excav., and for 5 manholes, each, $33.12.

**Newton, N. J.*—At a meeting of the Town Committee on Oct. 3, Hinman & Sproul, of Schenectady, N. Y., were awarded the contract for building complete two sewage purification plants for $29,618 (bids opened Sept. 2).

Newark, N. J.—Edw. S. Rankin, Engr. Bd. Street and Sewer Comrs., writes that new bids will be received until Oct. 12 for constructing the first division of the Cli[illegible]on annexation sewers, Section No. 3. The bids for this work were previously opened on June 22, and the contract awarded to the McGovern Constr. Co. For list of bids received for this work see issue of The Engineering Record July 1.

Monmouth Beach, N. J.—The Monmouth Beach Protective Assoc., composed of prominent New Yorkers and Philadelphians, with summer homes at this place, have retained Alex. Potter, Consulting Engr., 143 Liberty St., New York, N. Y., and he has prepared plans for a system of sewers and sewage disposal for the town. The construction of this work will, in all probability, be commenced early in the spring.

**Jersey City, N. J.*—Patk. Connelly, 13 E. Hamilton Pl., has secured the contract for constructing a sewer on West Side Ave. from Fish St. to connect with Swampy Creek sewer, at 94 per cent. of the standard cost (bids opened by the Street and Water Comrs., Geo. T. Bouton, Clk., on Oct. 2). The estimate of quantities for this work is as follows: Circular brick sewer—630 lin. ft. 72-in., 245 lin. ft. 66-in., 240 lin. ft. 57-in., 245 lin. ft. 36-in., 245 lin. ft. 48-in.; 135 ft. 18-in. vitr. pipe; 100 cu. yd. concrete; 150 cu. yd. brick masonry; 4,000 lin. ft. piles driven; 8 M. ft. capping; 12.8 M. ft. flooring and 40 M. ft. sheathing; 17 receiving basins; 11,500 cu. yd. earth fill; 13,000 sq. ft. flag; 3,250 lin. ft. curb, and 1,100 sq. yd. repaving Belgian in gutters.

Camden, N. J.—The City Council is reported to have decided to abolish the Line Ditch nuisance in the southern section of Camden. Sewers will be constructed to drain the meadows, and they will be filled in.

New York, N. Y.—Bids will be received until Oct. 17 by John F. Ahearn, Boro. Pres., for furnishing material and constructing sewers in portions of 4 streets. Engineer's estimate: 771 lin. ft. 15 in. salt-glazed vitr. stoneware pipe sewer; 63 lin. ft. 12 in. salt-glazed vitr. stoneware pipe culvert; 180 lin. ft. 4 x 2 ft. 8-in. brick sewer; 892 lin. ft. 3 ft. 6 in. x 2 ft. 4 in. brick sewer; 81,000 ft. B. M., timber and planking for bracing and sheet piling; 24,000 ft. B. M. timber and planking for foundation, etc.

Portchester, N. Y.—It is stated that bids will be received until Oct. 12 by Clement D. Camp, Village Clk., for constructing a drain in King St. and Poningo St. Drainage Dist.

Hamburg, N. Y.—Engr. Dennison Fairchild is reported to be preparing an estimate of the cost of constructing a sewer in Union St. bet. Center and Lake Sts.

Lexington, N. C.—See "Water."

Waynesville, N. C.—It is stated that bids will be received until Oct. 14 by the Mayor and Bd. of Aldermen for furnishing material and constructing 9,500 ft. 8-in. sewer, 2 flush tanks and 12 manholes. C. G. Logan, Supt. Water Wks.

Lisbon, O.—Bids will be received until Oct. 9 by the Bd. Co. Comrs. (Eden Reeder, Chmn.) for furnishing material and constructing a stone box culvert with wing walls on the line of the townships of Salem and Butler.

Portsmouth, O.—Bids will be received until Oct. 26 by the Bd. Pub. Service for constructing a main sewer, manholes, catch basins, branches, etc., and outlet on Robinson Ave., from Lincoln St. to Lawson Run, as advertised in The Engineering Record; estimated cost, $35,000.

Elyria, O.—Scott Hinman, Clk. Bd. Pub. Service, writes that no bids will be received on Oct. 15 for the construction of a 36-in. brick and 24-in. pipe sewer, as previously reported. He further states that no bids have as yet been asked for this work.

Youngstown, O.—Bids will be received until Oct. 12 by the Bd. Pub. Service (G. T. Prosser, Clk.), for constructing a sewer in a portion of Lydia St.

Wauseon, O.—Bids will be received until Oct. 23 at the office of A. S. Bloomer, Village Clk., for constructing sewers in portions of 4 streets.

Hamilton, O.—The following are reported to be the bids opened on Sept. 20 for the construction of a sanitary sewer on Maple and East Ave. and Ludlow, Sycamore and 7th Sts.: J. W. Kindred, $8,989; W. H. Louthan, $7,136, and John Arpp, Middletown, $8,816.

Dayton, O.—The following are reported to be the bids opened on Sept. 29 by the Bd. of Pub. Service for constructing sanitary sewers in Dist. 4: Paul & Kershner, $11,642; M. O. Herron & Co., $11,806, and Philip W. Minnigan, $11,054.

Columbus, O.—Bids will be received by the Bd. of Pub. Service until Nov. 2 for furnishing material and constructing sewerage purification works, having a capacity of 20,000,000 gal. per day, as advertised in The Engineering Record. The works will cover a total area of about 46 acres, and consist principally of 6 septic tanks, 4 sprinkling filters, a gate house, 2 open settling basins, a pump house, minor appurtenances and a levee around the works about 5,000 ft. long.

**Portland, Ore.*—Bechill Bros. are stated to have secured the contract for constructing sewers in Haight, Gantenbein and Vancouver Aves. and Failing St. for $13,060.

Montooth, Pa.—Bids will be received until Oct. 11 by Edw. J. Gaul, Boro. Clk., Lincoln and Paul Aves., Montooth, for constructing a vitrified pipe sewer in a portion of Paul Ave., including house connections. C. F. Southard, Boro. Engr., 426 Frick Bldg., Pittsburg.

Williamsport, Pa.—Bids will be received by the Highway and Sewer Com. at the office of J. J. Galbreath, City Clk., until Oct. 12 for furnishing material and constructing a storm sewer 5,700 ft., consisting of concrete, brick and terra-cotta construction, as advertised in The Engineering Record.

Reading, Pa.—Bids will be received until Oct. 12 by the Bd. Pub. Wks., care of Chas. C. Weltmer, City Clk., for repairs and alterations necessary to increase the capacity of the city's sewage disposal plant at Wilmont. Bids to be submitted separately on the following: For furnishing all material, labor and appliances necessary to increase the capacity of the present plant to 7,000,000 gal. per 24 hours; maintain and operate the sewage pumping station and disposal plant for a period of 5 years, with the maximum capacity of the plant 7,000,000 gal. in 24 hours. Appropriation reported to be $24,500. Elmer H. Beard, City Engr.

Chatham, Va.—L. S. Randolph, of Blacksburg, Va., has completed plans and specifications for the sewerage disposal system for the Chatham Episcopal Institute at Chatham.

Seattle, Wash.—An ordinance has been passed providing for the construction of a sewer in Weller St., to cost about $4,780.

North Yakima, Wash.—The City Council on Sept. 18 passed a resolution adopting the plans of E. McCulloh, City Engr., for the construction of a system of main sewers, to consist of 19,155 ft. vitr. pipe, 10 and 18 in., and 3,350 ft. 16-in. wood stave pipe outlet. An election to vote on issuing $48,000 bonds for same will be held on Oct. 12, and if carried bids will be opened on Nov. 6.

**Spokane, Wash.*—Jas. C. Broad, 106 Post St., is stated to have secured the contract for constructing the Sherman St. sewer on Sept. 27 for $4,565.

Green Bay, Wis.—It is reported that bids will be received until Oct. 12 at the office of the City Clk. for furnishing material and constructing an 18-in. vitr. pipe sewer in a portion of Quincy St.

BRIDGES.

Notes Arranged Alphabetically by States.

San Jose, Cal.—Bids will be received until Oct. 16 by the Bd. Co. Superv. (Henry A. Pfister, Clk.) for constructing a bridge across Guadalupe Creek on Willow St.

Ventura, Cal.—The Bd. of Supervisors is reported to have under consideration the construction of two bridges, to cost about $50,000, one over Sespe Creek near Fillmore, and the other over Ventura River at Casitas Pass.

Wilmington, Del.—See "Miscellaneous."

Rome, Ga.—It is reported that bids will be received until Oct. 11 by the Bd. Co. Comrs. (J. R. Cantrell, Chmn.) for constructing a 36-ft. span steel bridge across Woodward's Creek, on the Calhoun Road.

Newport, Ind.—It is stated that bids will be received until Oct. 19 by the Co. Comrs. for constructing a bridge and its abutments across Little Raccoon Creek inHelt Township. H. T. Payne, Co. Aud

**Leavenworth, Kan.*—M. A. Przbylowicz, City Clk., writes that the contract for constructing a steel I-beam bridge at 8th and Shawnee Sts. (bids opened Sept. 6) has been awarded to McGuire & Stanton, of Leavenworth, for $6,249.

**Cambridge, Mass.*—The following are reported to be the bids opened on Sept. 28 for constructing bridge and abutments at crossing of 1st and Main Sts., Cambridge (bidders all of Boston): T. H. Gill & Co., $37,230; Metropolitan Const. Co., $33,719; Gow & Palmer, $33,585; Holbrook, Cabot & Rollins, $30,704; Woodbury & Leighton Co., $29,485; Wm. L. Miller, $27,445; Wm. Crane, 7 Water St., $27,375 (awarded contract).

**Detroit, Mich.*—F. J. Miller & Bro. have secured the contract for constructing two concrete and steel

Items marked thus give the names of parties awarded contracts.

Washington, D. C.—The following are the bids opened on Sept. 25 by Lieut. Col. R. L. Hoxie, Corps Engrs., U. S. A., for constructing concrete-steel arch bridge, in the approach to highway bridge across Potomac River at Washington: (*a*) Cranford Co., (*b*) Monolith Reinforced Concrete Co., New York, N. Y., (*c*) Abbott-Gamble Co., New York, N. Y., (*d*) McMullen & McDermott, Washington, D. C., (*e*) Penn Bridge Co., Beaver Falls, Pa., (*f*) Ambrose B. Stannard, New York, N. Y., (*g*) Jas. A. Hart Co., New York, N. Y., (*h*) Miller-Collins Co., New York, N. Y., (*i*) Crouse Constr. Co., Perth Amboy, N. J., (*j*) Bell Eng. & Constr. Co.:

	a	*b*	*c*	*d*	*e*	*f*	*g*	*h*	*i*	*j*
Bridge complete with concrete facing	$126,700	$185,000	$141,000	$128,055	$97,367	$204,000	$130,600	$100,000	$146,976	$154,891
Bridge complete, with stone facing	...	198,000	150,000	134,555	109,000	226,000	152,000	...	...	...
Removal of 550 cu. yds. concrete	3750.00	2475.00	2750.00	3300.00	825.00	1100.00	2750.00	825.00	1100.00	1320.00
Excavation, 650 cu. yds.	585.00	650.00	1625.00	1300.00	1625.00	1300.00	650.00	455.00	682.00	617.50
Dredging, per cu. yd.	.90	.90	5.00	2.00	.40	2.00	2.00	.70	.90	.75
Land excavation, per cu. yd.	2.00	.80	2.50	2.00	1.20	11.00	3.00	1.00	.70	1.00
Foundation piles, per lin. ft.	.39	.50	.60	.28	.35	.42	.50	.25	.35	.40
Concrete, Class 1, per cu. yd.	6.75	6.50	7.00	10.00	6.00	6.50	9.00	5.75	7.95	9.02
Concrete, Class 2, per cu. yd.	6.50	6.25	7.00	10.00	5.50	6.30	9.00	5.50	7.95	8.40
Concrete, Class 3, per cu. yd.	10.00	15.00	17.00	10.00	6.50	14.00	12.00	11.00	9.50	10.75
Concrete, Class 4, per cu. yd.	29.00	30.00	27.00	10.00	18.50	20.00	80.00	25.00	14.00	12.00
Concrete, Class 5, per cu. yd.	4.90	4.50	4.50	10.00	4.00	4.00	5.00	3.50	8.00	7.15
Steel reinforcement, per lb.	.055	.04	.04	.025	.03	.04	.06	.05	.04	.05
Sand filling, per cu. yd.	.90	.75	2.00	2.00	1.00	3.00	1.50	1.00	1.60	1.50

bridges on Jefferson Ave. over Connors and Fox creeks, in Grosse Point Township, for $20,049. Engineer, W. F. Brown, of Toledo, O.

Two Harbors, Minn.—Bids will be received until Oct. 17 by the Bd. Co. Comrs. for constructing a steel bridge across Knife River, at the town site of Knife River. John P. Paulson, Co. Aud.

Duluth, Minn.—This city will expend about $13,000 for repairs to Lake Ave. viaduct.

Miamisburg, O.—Bids, including plans and specifications, will be received until Oct. 21 at the office of T. J. Kauffman, Co. Aud., Dayton, for removing Kercher St. canal bridge, masonry and approaches, and erecting a swing bridge on the present site of bridge on Kercher St.

Marion, O.—It is reported that bids will be received by the Bd. Co. Comrs. until Oct. 24 for furnishing material and constructing a steel bridge across Scioto River, to be known as the Newman Bridge; probable cost, $7,730. L. M. Hipsher, Co. Aud.

Refton, Pa.—Bids will be received by the Bd. Co. Comrs., at Lancaster until Oct. 30 for the superstructure of a highway bridge across Big Beaver Creek, on the line between Strasburg and Providence townships. M. G. Schaeffer, Co. Comp.

Bids will be received same date for furnishing material and doing the masonry work for above bridge.

Chattanooga, Tenn.—The Mayor and Bd. of Aldermen are stated to have authorized the Bd. of Pub. Wks. to issue $12,000 bonds for the erection of a steel viaduct, to be used in opening 11th St.

Spokane, Wash.—Bids will be received until Oct. 19 by the Bd. Pub. Wks. (F. P. Weymouth, Pres.) for constructing a bridge across Spokane River at Mission Ave. to carry the new water main, to consist of one 150-ft. span and two 100-ft. spans, or four 92-ft. spans, and to have a 12-ft. roadway. Plans may be submitted for either a steel superstructure with tubular piers or for a reinforced concrete, with concrete superstructure.

PAVING AND ROADMAKING.

Notes Arranged Alphabetically by States.

Ft. Smith, Ark.—The City Council will be asked to put an asphalt covering over the brick paving on Garrison Ave.

The city is in the market for 200,000 paving brick for repair work.

Lake City, Fla.—See "Sewerage and Sewage Disposal."

Atlanta, Ga.—H. L. Collier, Comr. of Pub. Wks., writes that the city is in the market for a 12-ton steam roller.

**Kewanee, Ill.*—The Bd. of Local Improv. is stated to have awarded the contract for paving with asphalt a portion of 2d St., to the Barber Asphalt Paving Co., Stock Exchange Bldg., Chicago, for $30,418.

**Urbana, Ill.*—The Bd. Pub. Improvements is stated to have awarded on Sept. 25 contracts for paving with brick W. High St., Busey Ave. and Oregon St., to J. W. Stipes, of Champaign, for $25,590.

Champaign, Ill.—The following bids are reported to have been opened Sept. 22 for paving Randolph St. with brick on a Portland cement foundation: John W. Stipes, of Champaign, $47,405, and A. D. Thompson, of Peoria, $48,717.

**Sterling, Ill.*—The following bids are stated to have been opened Sept. 19 for paving with brick W. 4th St., about 17,627 sq. yd. being required: A. E. Rutledge, $23,297; Chas. Besler (2 bids), $23,310 (awarded contract) and $24,270; A. D. Thompson, $24,680; Smith & Brown, of Chicago, $26,795; Rourke & Ridge, $26,560, and M. Ford, of Peoria, $25,326.

Danville, Ind.—It is reported that bids will be received until Oct. 14 by the Bd. Co. Comrs. for improving about 13,574 ft. Stitesville gravel road; also 10,750 ft. Eminence gravel road. David D. Mills, Co. Aud.

Muncie, Ind.—The Bd. of Wks. is stated to have opened on Sept. 13 bids for macadamizing E. Bright St. as follows: W. N. Burch, $1.41 per sq. yd., and A. R. & J. D. Mock, $1.59½ per sq. yd.

Cumberland, Md.—Bids will be received until Oct. 11 by the Road Directors of Allegany County at Cumberland (D. F. McMullen, Chmn.), for grading and macadamizing about one mile of road.

**Boston, Mass.*—The following are reported to be the bids opened on Sept. 25 for paving and regulating Atlantic Ave. from Broad to Commercial St.: Frank Williams, $24,515; J. J. Sullivan, $9,141; W. J. Rafferty, $8,534; D. D. Lynch, $7,810; Robt. Brown, $7,642; Globe Constr. Co., $7,284; J. J. Coughlin Constr. Co., $7,107; Brennan & Co., $6,807; John McCourt, $6,705; D. J. Kiley, $6,605, and Robt. Edger, Roxbury, Mass., $5,848 (awarded contract).

**Niles, Mich.*—The contract for paving 4th St. (bids opened Sept. 25) is stated to have been awarded to the Barber Asphalt Paving Co., Hammond Bldg., Detroit, at $1.72 per sq. yd.

**Muskegon, Mich.*—The Barber Asphalt Co., of Detroit, is stated to have received the contract for paving with bituminous macadam on Erwin St., at $1.74 per sq. yd.

**Kansas City, Mo.*—The following contracts are stated to have been awarded on Sept. 28 for paving with asphalt portions of Bway and 9th Sts. The Lutz Asphalt Maintenance Co., at 98 cts. per sq. yd.; portions of Central, and 13th Sts., and Missouri Ave., to the Economic Repair Co., at $1.10 per sq. yd.; portions of Baltimore Ave. and Locust St., to Barber Asphalt Paving Co., New Nelson Bldg., at $1.90 and $2.15 per sq. yd., respectively.

**Macon, Mo.*—C. J. Du Bois, City Engr., writes that G. Kohl, of Mason, has secured the contract for about 2,500 sq. yds. paving (bids opened Oct. 2) for $6,878.

Concord, N. H.—Bids will be received until Oct. 13 by A. W. Dean, State Engr., for constructing macadam and gravel roads in 4 towns.

**Rye, N. H.*—A. W. Dean, of Concord, State Engr., writes that the contract for constructing a section of State road in Rye (bids opened Sept. 26) has been awarded to Hett Bros., of Portsmouth, for $5,575.

**Newark, N. J.*—The contract for paving Elizabeth St. with 8,000 sq. yd. brick paving on 6-in. concrete foundation and 1,000 lin. ft. 20-in. curb set in concrete has been awarded to the Harrison Constr. Co., of Newark, for $16,428. Bids opened Sept. 28 by the Bd. of Street and Water Comrs. (Morris R. Sherrerd, Ch. Engr.)

New York, N. Y.—The following are the bids opened on Sept. 28 by John F. Ahearn, Pres. Manhattan, for regulating and repaving with asphalt on concrete foundation Lenox Ave., from 125th to 135th St.: Asphalt Constr. Co., $25,980; Barber Asphalt Paving Co., 114 Liberty St., $24,567; Century Constr. Co., $33,209; Uvalde Asphalt Paving Co., $27,075; Sicilian Asphalt Paving Co., $24,965. The detail bid of the lowest bidder, the Barber Asphalt Co., is as follows: 19,950 sq. yds. asphalt pavt., including binder course, 80 cts.; 1,880 cu. yds. 3-in. concrete, $3.40; 3,300 lin. ft. new bluestone curb, 60 cts.; 1,500 lin. ft. old curb reset, 35 cts., and 2 covers for manholes, ea., $15.

Bids will be received by John F. Ahearn, Boro. Pres., until Oct. 17 (readvertisement) for furnishing material, regulating and repaving portions of 10 streets. Engineer's estimate: 68,681 sq. yd. wood blk. pav't.; 19,703 cu. yd. concrete, including mortar bed; 19,805 lin. ft. new bluestone curb, furnished and set; 108 noiseless covers, complete, for sewer manholes, furnished and set; 149 noiseless covers, complete, for water manholes, furnished and set, etc.

The following are the bids opened on Sept. 28 by John F. Ahearn, Pres. Manhattan Boro., for regulating, grading, curbing and flagging 169th St. from Broadway to Ft. Washington Ave.: P. J. Kane, $27,507; P. J. Duffy, $24,702; John C. Rodger, $23,700; F. B. Smith Contr. & Engr. Co., $24,891; Troy Pub. Wks. Co., of Utica, $20,803; John F. Sheald, $30,528; F. W. Malloy, $22,944; J. C. Voorhees, $24,899; A. S. Traub, $23,173; J. J. Hart Co., $24,630. The detail bid of the lowest bidder, the Troy Public Wks. Co., is as follows: 1,609 cu. yds. earth excav., 60 cts.; 11,622 cu. yds. rock excav., $1.85; 1,400 lin. ft. new curb, 75 cts., and 5,500 sq. ft. new flag, 27 cts.

Bids were opened same time and place for grading, curbing, recurbing and flagging: (*a*) 164th St. from Bway. to Ft. Washington Ave.; (*b*) W. 163d St. from Bway. to Ft. Washington Ave.: P. J. Kane, *a* $36,714, *b* $32,008; P. J. Duffy, *a* $29,747, *b* $25,842; John C. Rodger, *a* $28,315, *b* $24,759; F. V. Smith Contr. Co., *a* $31,025, *b* $27,054; Troy Public Works Co. of Utica, *a* $26,738, *b* $24,810.

New York, N. Y.—The following are the bids opened on Sept. 28 by John F. Ahearn, Pres. Manhattan Boro., for regulating and repaving with asphalt on present pavement laid as foundation portion of Monroe St.: (*a*) Barber Asphalt Paving Co., $20,832, (*b*) Uvalde Asphalt Paving Co., $20,299, (*c*) Sicilian Asphalt Paving Co., $36,054:

	a	*b*	*c*
11,850 sq. yds. asphalt pavt., including binder course	$1.74	$.90	$2.15
11,850 sq. yds. old stone pavt., relaid as foundation	.28	.33	.40
6,350 lin. ft. new curb	.81	.78	.80
470 lin. ft. old curb reset	.29	.33	.30
41 noiseless covers for manholes	15.00	15.00	15.00

New York, N. Y.—All bids opened on Sept. 28 by John F. Ahearn, Pres. Manhattan Boro., for wood block pavement on a concrete foundation have been rejected. The following are totals of bids received: (*a*) West Bway. from Dey St. to W. 4th St., (*b*) Bway. from Vesey St. to Battery Pl., (*c*) Battery Pl. from Bway. to West St., (*d*) Park Pl. from Bway. to West St.: (1) Eppinger & Russell Co., 66 Broad St., *a* $144,706, *b* $54,392, *c* $32,770, *d* $24,790; (2) Franklin Contr. Co., 1 Hudson St., *a* $141,257, *b* $63,885, *c* $31,772, *d* $23,925; (3) Republic Contr. Co., *a* $173,441, *b* $61,763, *c* $32,195, *d* $24,148; (4) U. S. Wood Preserving Co., 29 Bway., *a* $136,867, *b* $60,841, *c* $30,914, *d* $23,101.

The detailed bid for paving W. Bway. from Dey St. to W. 4th St. with wood block, opened on Sept. 28 (totals for which are given above) is as follows:

	(1)	(2)	(3)	(4)
28,919 sq. yds. wood block pavt.	$3.48	$3.29	$3.20	$3.17
8,370 sq. yds. old pav't to be removed	.21	.14	.12	.13
4,237 cu. yds. concrete, including mortar bed	6.75	6.90	6.90	6.95
11,660 lin. ft. new curb	1.00	1.00	.96	.95
710 lin. ft. old curb, reset	.40	.50	.40	.35
115 noiseless covers for manholes	18.00	18.00	18.00	18.00
20,549 sq. yd. old paving block to be purchased by contractor and removed	.70	.65	.90	.60

**Tuckahoe, N. Y.*—Thos. J. McCarthy, Village Clk., writes that Bellew & Merritt Co., of Tuckahoe, have secured the contract for improving Breckenridge St. (bids opened Oct. 3) for $4,220.

Rensselaer, N. Y.—Bids will be received until Oct. 17 by John G. Salt, City Clk., for grading, curbing and paving with asphalt a portion of Riverside Ave.

Johnstown, N. Y.—The following are the bids opened on Oct. 2 for paving Market St. with asphalt block, (*a*) J. R. Baxter, Jr., Utica; (*b*) Hinman & Sproul, Schenectady; (*c*) Baird, Conover & Reid, Amsterdam; (*d*) Hastings Pav't Co., New York:

	a	*b*	*c*	*d*
10,000 sq. yd. asphalt block	$2.25	$2.53	$2.58	$2.27
3,533 ft. reset old curb	.29	.25	.30	.28
1,312 ft. new stone curb	.78	.87	.75	.70
695 ft. headers	.45	.75	.60	.50
960 cu. yd. excav. in R. R. track	.75	.35	.75	.85
760 cu. yd. broken stone in R. R. track	2.25	2.25	1.25	2.00

Johnstown, N. Y.—The following are the bids opened on Oct. 2 for paving Perry St. with asphalt block, 1,800 sq. yd. (price given per sq. yd.): J. R. Baxter, Jr., Utica, $2.30; Hinman & Sproul, Schenectady, $2.53; Baird, Conover & Reid, Amsterdam $2.53, and Hastings Pav't Co., New York, $2.27.

**Rochester, N. Y.*—The Bd. of Contract is stated to have awarded the contract for paving with brick a portion of Thorn St. to H. B. Hooker & Son, Wilder Bldg., for $5,404.

Lexington, N. C.—See "Water."

Cincinnati, O.—Bids will be received by the Bd. Pub. Service (Geo. F. Holmes, Clk.) until Oct. 24 for furnishing material and improving a portion of Ashland Ave. by grading, curbing and macadamizing.

Springfield, O.—Bids will be received by the Bd. Pub. Service (Chas. C. Bauer, Clk.) until Oct. 12 for furnishing material, grading, graveling and constructing cement combined curbing and gutters on portions of Bway., Grant and Factory Sts.; also grading and macadamizing portions of Fremont Ave. and Catherine St.

*The Springfield Paving Co. has secured the contract for paving the alleys, bids for which were recently opened, at $1.49 per sq. yd., using Hocking Valley block.

Miamisburg, O.—Press reports state that bids will be received until Oct. 24 by Chas. F. Eck, Clk. Village, for $8,682 paving bonds.

Bellaire, O.—Bids will be received by the Bd. Pub. Service (F. A. Jackson, Clk.) until Oct. 12 for furnishing material and improving a portion of Central Ave, by grading and paving.

Dayton, O.—Bids will be received until Oct. 12 by the Bd. Pub. Service (Wm. F. Miller, Clk.) for laying sidewalks, curbing and guttering portions of several streets.

The Bd. of Pub. Service is stated to have opened on Sept. 29 bids for paving a portion of Oak St., as follows: Fred W. Kroemer (Townsend block) $19,692, (Twentieth Century) $19,879; Wm. J. Kernan (Hocking Valley) $16,807, (Dogan), $17,365; (Holan), $17,365; M. O'Herran & Co. (Hocking Valley block), $17,516; (Logan) $17,609; (Nelsonville) $17,702; (Athens), $17,609; (Metropolitan), $17,702; J. O. Shoup & Co. (Townsend block), $16,967; (Hocking), $16,967; (Creosote), $28,127; J. E. Conley (Logan block), $16,423; (Metropolitan), $16,888; (Harris paver), $16,702; (Hocking Valley), $16,609; Warren Bros. and Co. (Bituminous macadam), $21,540; (Sheet Asphalt), $15,852; David Beard (Gloucester block), $16,807; (Wassell), $16,830; (Trimble), $16,853; (Carlisle), $17,271; (Townsend), $17,272; Couch & Kunkle (Twentieth Century), $16,869; (Buckeye), $16,962; (Harris paver), $17,055; (Townsend), $17,148; A. Wroe & Son (Hocking Valley), $17,563; David Onkst (Hocking Valley), $16,831; (Twentieth Century), $18,040; (Harris), $17,854.

Zanesville, O.—It is stated that bids will be received until Oct. 14 by the Bd. Pub. Service for paving and curbing Fountain Sq. E. H. Smith, City Engr.

Hoytsville, O.—Press reports state that bids will be received until Oct. 30 by Trenton O. Copus, Village Clk., for $4,000 street improvement bonds.

Norwalk, O.—A resolution has been passed declaring it necessary to pave E. Main St. with brick; probable cost, $10,000. T. P. Kellogg, City Clk.

Ashland, Ore.—It is reported that bids will be received until Oct. 17 by the Mayor and City Council for furnishing material, grading, curbing and paving a portion of Sandusky St. C. P. Winbiglerm, Mayor.

Erie, Pa.—Bids will be received until Oct. 18 by the State Highway Dept. (Jos. W. Hunter, Comr.), Harrisburg, for constructing 11,813 ft. road in Springfield Township, Erie Co.

**Philadelphia, Pa.*—The Barber Asphalt Paving Co. is reported to have secured the contract for about $700,000 worth of paving; their average price per sq. yd. was $1.52.

Reading, Pa.—The Select Council is stated to have passed a resolution providing for the appropriation of $10,000 for repairing pavements throughout the city.

Harrisburg, Pa.—It is stated that bids will be received until Oct. 18 by the State Highway Dept. at Harrisburg, for constructing 5,555 ft. of road, also 2,100 ft. of brick paving in Crawford County.

Items marked thus give the names of parties awarded contracts.

New York, N. Y.—The following are the bids opened on Sept. 28 by John F. Ahearn, Pres. Manhattan Boro., for repaving with asphalt on a concrete foundation Lenox Ave., from 135th to 145th St. (*a*) Asphalt Constr. Co., Madison Ave. and 137th St., (*b*) Barber Asphalt Paving Co., 114 Liberty St., (*c*) Century Constr. Co., 7 E. 42d St., (*d*) Uvalde Asphalt Paving Co., 1 Bway., (*e*) Sicilian Asphalt Paving Co., 41 Park Row.

	a	*b*	*c*	*d*	*e*
20,200 sq. yds. asphalt pavt., including binder course	$.80	$.80	$1.00	$.75	$1.10
1,950 cu. yds. of concrete, 3 in	4.00	3.40	5.50	4.75	5.50
3,600 lin. ft. new curb	.70	.68	.88	.78	.80
1,500 lin. ft. old curb	.32	.35	.25	.33	.30
Total	$26,990	$25,505	$34,508	$27,745	$36,305

Westchester, Pa.—Bids will be received until Oct. 18, by the State Highway Dept. Harrisburg (Jos. W. Hunter, Comr.), for constructing 6,785 ft. State road in East Marlboro Township, Chester Co.

Bids will also be received by the State Highway Dept. (Jos. W. Hunter, Comr.), Harrisburg, until Oct. 18, for constructing 17,500 ft. road in Schuylkill Township, Chester Co.

Altoona, Pa.—Bids will be received until Oct. 10 by the Bd. Pub. Wks. (And. Kipple, Chmn.) for curbing and paving with vitrified brick portions of four streets.

Nashville, Tenn.—Press reports state that bids will be received until Oct. 10 by the Finance Committee, for $125,000 suburban street improvement bonds.

Dallas, Tex.—It is proposed to pave Ervay St. with asphalt or bituminous pavement and 2d Ave. with macadam. Address E. L. Dalton, City Engr. J. B. Winslett is City Secy.

Sherman, Tex.—Bids will be received by Henry Zimmerman, City Secy., until Oct. 23 for paving portions of Travis, Crockett, Houston and Mulberry Sts. with vitrified brick, about 14,290 sq. yd., and 4,145 lin. ft. stone curb, as advertised in The Engineering Record.

Seattle, Wash.—An ordinance has been passed ordering the improvement of Westlake Ave. from Pike St. to Denny Way by paving same with asphalt, at a cost of $40,000. Work will commence about the first of the year.

Beloit, Wis.—Bids are wanted until Oct. 23 for grading and macadamizing about 10,000 lin. ft. Robt. Caldwell, City Engr.

Green Bay, Wis.—It is stated that bids will be received until Oct. 20 by the Com. on Streets & Bridges for about 8,329 sq. yds. macadam pavement and 600 cu. yds. excav. W. W Read, City Engr

Mt. Pleasant (P. O. Vancouver), B. C.—Bids will be received by W. G. Walker, Mt. Pleasant, until Oct. 14 for $50,000 bonds for constructing roads in South Vancouver.

Toronto, Ont.—C. H. Rust, City Engr., writes that nothing definite has yet been done with regard to the speedway on the east bank of the Don; it will probably not cost more than $2,500.

POWER PLANTS. GAS AND ELECTRICITY.

Notes Arranged Alphabetically by States.

Courtland, Ala.—It is reported that Lawson, Sykes & Co. want prices on machinery and equipment for an electric light plant.

Roosevelt, Ariz.—Plans and specifications are on file at the office of The Engineering Record, 114 Liberty St., New York, N. Y., for furnishing complete, f. o. b. bidders' works, one or more alternating-current, 900-kw., 25-cycle generators; one or more 100-kw., direct-current generators for exciter, and one switchboard, for use in Roosevelt power house, bids for which will be received until Nov. 1 at the office of O. H. Ensign, Electrical Engr., 398 Pacific Electrical Bldg., Los Angeles, Cal. Specifications are also on file for one or more 1,260-hp. water wheels and one or more 140-hp. water wheels with gate valves, pipe connections and generators, for the Roosevelt power house, bids to be opened at the same place on Nov. 2.

Ukiah, Cal.—The Supervisors are reported to have granted the Eel River Power & Irrigation Co. a franchise for a transmission line from Potter Valley to Ukiah.

Greeley, Colo.—The Home Electric Light & Power Co. is reported to have increased its capital from $4,500 to $50,000, and will enlarge its plant and supply the entire town. Prof. Hayes, Vice-Pres. of the State Normal School, is an officer of the company.

Washington, D. C.—The following are the bids opened on Sept. 30 at the office of Elliott Woods, Supt. U. S. Capitol Bldg. and Grounds, for furnishing material and installing a complete heating, lighting and power plant in a building and on foundations to be provided by the United States, in locations within the Capitol, Congressional Library, Senate and House Office Buildings; Carl Leonard De Muratt Co., New York, N. Y. (2 bids), $1,164,700 and $1,119,800. Lynch & Woodward, Boston, Mass., $862,726; Westinghouse Electric & Mfg Co., Pittsburg, Pa. (3 bids), $901,736, $1,119,584 and $1,084,369. McIntosh & Seymour, New York, N. Y., $903,730; Hanley-Casey Co., Chicago, Ill. (4 bids), $1,047,298, $1,031,199, $971,198 and $047.881. J. G. White & Co., New York, N. Y. (5 bids), $995,675, $1,033,646, $1,059,299, $1,189,250 and $1,199,869. Schofield Co., Philadelphia, Pa. (3 bids), $1,009,373, $1,050,680 and $1,015,450.

Bids will be received until Oct. 17 at the Bureau Supplies and Accounts, Navy Dept., Washington, to furnish at the Navy Yards, etc., Portsmouth, N. H.; Boston, Mass.; Newport, R. I.; New York, N. Y.; League Island, Pa.; Annapolis, Md.; Washington, D. C.; and Norfolk, Va., a quantity of Naval Supplies, as follows: Incandescent lamps; electrical supplies; double conductor; switch stands; outlet boxes; Holophane hemispheres; wireless clusters; electric deck hoists; steel conduit; drilling and milling machine; power trimming press; sheet brass; bar steel, etc. H. T. B. Harris, Paymaster Gen., U. S. N.

Rockmart, Ga.—It is stated that this city will issue bonds and construct a municipal electric light plant.

Chicago, Ill.—John H. Radford is reported to be preparing plans for an addition to the electric light plant at 58th St. and Cottage Grove Ave., Washington Park, for the South Park Comrs.

**Cicero, Ind.*—The Sanborn-Marsh Electric Co., of Indianapolis, are reported to have secured the contract for constructing an electric light plant at Cicero.

Vinita, Ind. Ter.—The plant of the Vinita Electric Light, Ice & Power Co. (P. L. Soper, Pres.) is reported to have been destroyed by fire on Sept. 26.

Muskogee, Ind. Ter.—G. W. Sargent, of Joplin, Mo., is stated to have petitioned for permission to construct a power plant to replace the one recently destroyed by fire.

**Ames, Ia.*—The Mitchell Vance Co. is reported to have secured the contract for the electric fixtures for the central bldg. of the State Agricultural College at Afnes, for $8,000.

Ludlow, Ky.—Bids will be received until Oct. 12 by the City Council for a franchise to lay, maintain and operate gas mains for a period of 20 years. J. C. Richardson, City Clk.

Williamsburg, Ky.—Taylor Gleaves, of Lynchburg, Va., writes that Gleaves & Co., of Lynchburg, Va., propose to construct and own water works and an electric light plant at Williamsburg, to cost about $45,000. Engineer, J. A. Gillman.

Eastport, Me.—The City Council is reported to have granted Chas. E. Capen a franchise for an electric light and power plant.

Baltimore, Md.—Bids will be received until Oct. 11 by the Bd. of Awards (E. Clay Timanus, Pres.), for furnishing, installing, operating and maintaining for a period of 1, 2, 3, or 5 years gasoline or naphtha, street or out-door lamps, with the use of incandescent mantle fixtures.

St. Cloud, Minn.—Saml. S. Chute, with four assistant engineers, is reported to have commenced a permanent survey for the Whitney dam across the Mississippi River. it will probably be 550 ft. in length and cost about $50,000.

Kansas City, Mo.—Bids will be received by the Secy., Treas. Dept., Washington, D. C., until Oct. 12, for manufacturing and placing in position, in the U. S. Court House and Post-Office, Kansas City, certain combination gas and electric light fixtures.

Ravenna, Neb.—The Village Trus. are reported to be considering the question of constructing an electric light plant.

Albuquerque, N. M.—The Albuquerque Light, Gas & Power Co. is reported to have decided to expend about $25,000 in improving its gas plant.

New York, N. Y.—Bids will be received until Oct. 12 by John F. Ahearn, Boro. Pres., for furnishing and setting lighting fixtures in the County Court House.

Syracuse, N. Y.—The Bd. of Contract and Supply rejected all bids received on Sept. 23 for street lighting and lighting the city buildings being considered excessive. New bids will be received by the Board until Oct. 9. Fred T. Pierson, Clk.

Phoenix, N. Y.—The Phoenix Fuel, Light & Water Co. is reported to have been granted permission by the State Comn. of Gas and Electricity to issue $100,000 bonds.

Hermon, N. Y.—The State Comn. of Gas and Electricity has granted the application of the Hermon Electric Light Co. to transact business and issue $15,000 of stock.

Auburn, N. Y.—The Auburn Gas Co. is reported to have decided to purchase the plant and franchise of the Citizens' Light & Power Co., of Auburn.

Brooklyn, N. Y.—The State Comn. of Gas and Electricity has granted permission to the Brooklyn Gas Co. to issue $615,000 bonds, of which $115,000 will be for improvements.

Lockport, N. Y.—The Economy Light, Heat, Power & Fuel Co. is stated to have petitioned Council for a franchise.

Utica, N. Y.—C. E. Parsons, Utica National Bank Bldg., Utica, Ch. Engr., Hudson River Electric Power Co., writes that the only new work contemplated is the construction of a 60,000-volt transmission line from Ballston to Utica. This line is now being surveyed, and construction will begin in about 30 days. Will use steel towers spaced about 550 ft. apart. The company expects to purchase the towers, but will itself erect them and put up the conductors.

Brevard, N. C.—J. W. Chapman, of Lawrenceville, Ga., writes with regard to the electric light plant proposed for Brevard that plans have not yet been completed for organization.

Fayetteville, N. C.—It is stated that bids will be received until Oct. 10 by H. R. Horne, Comr. Pub. Wks., for extensions and changes to the municipal lighting plant.

Astoria, Ore.—W. W. Whipple is reported to have secured a franchise to construct an electric light and gas plant and telephone system.

**Philadelphia, Pa.*—The Philadelphia Electric Co. is stated to have secured the contract for lighting the city with electricity during 1906, for a total of $1,073,271.

Greenville, Tex.—J. B. Murphy and J. O. Hayter are reported to have secured a franchise for a gas plant.

Santa Anna, Tex.—The Santa Anna Water & Gas Co. is reported incorporated, with a capital of $25,000, by W. B. Mitchell, Fred W. Turner and others, all of Santa Anna.

Brownwood, Tex.—The Federal Gas Co. (W. H. McGoldrick, Treas.) has secured a franchise for the construction of a gas plant.

Ashland, Va.—G. B. Williams, of Richmond, Secy. and Treas. of the Virginia Light & Power Co., recently incorporated, writes that the company proposes furnishing a light and power service. No engineer has been appointed yet, and no bids have been asked for. This was recently reported under Ashland, Ky., but the work contemplated is at Ashland, Va.

Spokane, Wash.—The Big Bend Water Power Co. is reported organized by J. H. Tilsey, John E. Peterson, Reuben Cross and others, to develop 15,000 h.p. about 28 miles down the river at a point about 3 miles below Lebray Bridge. Engineer, E. Tappan Tannant.

Tacoma, Wash.—The Nisqually Power Co. is reported incorporated by R. L. McCormick, Secy. of the Weyerhauser Co.; Edw. Cookingham, Pres. of the Tacoma Eastern R. R. Co., and others, to construct a power plant near the Tacoma Eastern R. R. below Eatonville.

North Yakima, Wash.—I. W. Anderson, of Spokane, is reported to have secured a franchise for a gas plant.

Martinsville, W. Va.—J. R. Gregory, City Engr., writes that the ctizens voted Sept. 28 to issue $12,000 bonds to complete the electric light and power plant.

Milwaukee, Wis.—Mayor Rose has signed the resolution which provides that $60,000 from the earnings of the Water Dept. be transferred to the general city fund, the money to be used for the purchase of a site for the proposed lighting plant.

The Milwaukee Coke & Gas Co. is reported to have filed a mortgage of $1,000,000 to cover an issue of bonds to be used for the purpose of enlarging its plant.

Port Washington, Wis.—Wm. A. Tholen, City Clk., writes that no engineer has as yet been engaged for the proposed water works and electric light plant; probable cost of construction, $75,000.

Salt Lake City, Utah.—The Inter-Mountain Power Co. is preparing to build a system of hydro-electric plants near Salt Lake City, with steam auxiliary. Capacity will be 5,000 hp. Plans and specifications are in course of preparation by Frank C. Kelsey, of Salt Lake City.

**Victoria, B. C.*—M. Hutchison, City Clk., writes that the Hinton Electric Co., of Victoria, has secured the contract for improvements to the electric light plant for $9,025.

Toronto, Ont.—C. H. Rust, City Engr., writes that nothing has yet been done toward the construction of the electric plant for the Island.

ELECTRIC RAILWAYS.

Notes Arranged Alphabetically by States.

San Jose, Cal.—The Directors of the Ocean Shore R. R. Co. are stated to have decided to receive bids for the construction of an electric power plant of 6,000 h.p. capacity near the shore of Half Moon Bay. It also decided to have the repair shop and other buildings erected there.

Marysville, Cal.—It is stated that the Nevada County Traction Co. (John Martin, Pres.) will probably construct its proposed road within the year. The line will connect Nevada City and Grass Valley and Auburn and Marysville, a distance of about 67 miles; probable cost, $2,000,000.

San Bernardino, Cal.—The San Bernardino Valley Traction Co. is stated to have filed a petition with the City Council for a franchise to build an electric railway to Redlands. A. C. Dorman, Pres.

San Francisco, Cal.—Papers of incorporation are stated to have been filed for the Sacramento and Lake Tahoe Ry. Co., which will operate from Sacramento to a point on the southern shore of Lake Tahoe, passing through Folson and Placerville. This main line will be about 125 miles long, and a branch line of about 40 miles in length will connect the main line with Newcastle and Auburn. Capital, $7,500,000. Incorporators: B. G. Raybould, W. S. Graham, of Auburn; Leo Alexander, Thos. H. Nichols, and others.

Cedartown, Ga.—The City Council is stated to have granted a franchise to H. N. Van Deventer, E. C. Benton and associates for a street railway system.

Boise, Idaho.—The Roberts & Abbott Co., of Cleveland, is reported to be doing the preliminary engineering work for a proposition to be known as the Boise Interurban Ry. Co. It contemplates building a line from Boise City to Caldwell, a distance of 30 miles, and another line from Boise City to Nampa, a distance of 38 miles. Surveys are also being made for a 14-mile spur line to Pearl.

East St. Louis, Ill.—The City Council on Sept. 25 passed an ordinance giving the St. Louis & Northeastern Ry. (McKinley Syndicate) permission to construct, operate and maintain an electric railway on Gross, Illinois, College and St. Louis Aves. and 15th, 10th, 3d and 5th Sts. Wm. McKinley, Pres., Urbana.

South Bend, Ind.—A street railway franchise is stated to have been introduced in the South Bend Council in favor of J. W. Mackenzie, of Portland, and L. M. Dooley, to connect South Bend and Raymond, which are 3 miles apart.

Indianapolis, Ind.—It is stated that the Indianapolis, Columbus & Southern Traction Co. is to build an extension to Seymour, 18 miles.

Indianapolis, Ind.—The Louisville & Indianapolis Traction Co. is reported to have filed articles of incorporation. Capital, $10,000. J. R. Schindel, Pres.; Saml Adams, Secy. It is the purpose of the company to build an electric railway between Louisville and Indianapolis.

Noblesville, Ind.—The Indianapolis, Hartford City & Eastern Traction Co. is stated to have asked for a franchise in this city. The company proposes to build from Indianapolis to Celina, O.

Bluffton, Ind.—A company is reported to have been formed to finance and construct the Marion, Bluffton & Eastern Interurban Ry., from Marion to Bluffton through Van Buren, Warren and Liberty Center. Capital, $500,000. L. C. Davenport, of Bluffton, Pres.; W. A. Kunkel, Secy. and Treas.

Bartlesville, Ind. Ter.—A company is stated to have been formed to build an electric railway between Bartlesville and Dewey. The promoters of the local company are: Wm. Johnson, of Bartlesville; W. M. Speck, of Dewey; John Overfield, of Independence, and W. T. Hutchings, of Muskogee.

Des Moines, Ia.—A. P. Chamberlain, F. C. Cummins and John McLennan, of Des Moines, are reported to be considering plans for the construction of an interurban electric railway from Clarinda via College Springs to Tarko, Mo.

***Items marked thus give the names of parties awarded contracts.**

Fairfield, Ia.—Engineers Cason & Barrett, Dwight Bldg., Kansas City, Mo., state that the survey of proposed route for an electric railway bet. Fairfield, Birmingham and Keosaqua, Ia., proved the route impracticable from both an engineering and financial standpoint, and was therefore abandoned. A new survey was started, however, for a route between Fairfield and Keosaqua, via Stockport. By connecting Fairfield and Keosaqua through Stockport instead of Birmingham, the road will be about 30 miles instead of 20. Henry S. Hackbusch, C. E. for Cason & Barrett, is still retained in charge of the field party.

Cumberland, Md.—The South Cumberland Electric Ry. Co. is reported incorporated with a capital of $30,000. Dirs.: Wm. E. Walsh, Peter J. Seaver, David A. Robb and others, all of Cumberland. The purpose of the company is to build an electric railway.

Helena, Mont.—The Helena Light & Ry. Co. is reported incorporated. Capital, $1,500,000.

**New York, N. Y.*—The contract for making wash-borings on the lines of the proposed Rapid Transit Ry. routes in Manhattan, Bronx, Brooklyn and Queens Boroughs, including such routes as pass under the East and Harlem Rivers and other navigable waterways, has been awarded to the Healy Sewer Machine & Constr. Co., 15 Beacon St., Boston, Mass., for $35,605. Bids opened on Sept. 20 by the Bd. of Rapid Transit R. R. Comrs. (Bion L. Burrows, Secy.)

The Rapid Transit Comn. is stated to have on Sept. 28 referred to its committee on contracts the application of the Interstate Tunnel Ry. Co. (John B. McDonald, Pres.) for a franchise to construct a railway tunnel under Hudson River from the New Jersey boundary line to Chambers St., and under the Boro. of Manhattan to Park Row.

Cincinnati, O.—The construction of an electric railway to connect with the Cincinnati city system is reported under consideration. Chas. Cooper, A. Heineman and S. Browne, of Reading, and Chas. Komar, of Sharonville, are stated interested in the project.

Ft. Worth, Tex.—The charter of the Ft. Worth & Mineral Wells Electric Ry. Co., of Ft. Worth and Mineral Wells, is reported filed. Capital, $250,000. The purpose is to construct an electric railway between Ft. Worth and Mineral Wells. Incorporators: Cicero Smith, D. M. Howard, H. N. Frost, all of Palo Pinto County, and others.

Brenham, Tex.—A. T. Fisher, of the San Marcos Valley Interurban Ry. Co., is reported interested in the construction of a proposed electric line from Brenham to La Grange.

Palestine, Tex.—J. V. Watkins, of Corsicana, is stated to have filed with the City Council an application for a franchise for an interurban railroad from Corsicana to Palestine, and an electric street car line.

Corsicana, Tex.—Engrs. Cason & Barrett, Dwight Bldg., Kansas City, Mo., have signed a contract for preliminary survey and investigation of proposed electric interurban road connecting Corsicana, Fairfield and Palestine, Tex., a distance of 75 miles. J. V. Watkins, of Corsicana, is promoting the enterprise. The route has already been looked over and Cason & Barrett will probably have their corps of engineers at work on the survey by Oct. 15th.

Winnipeg, Man.—The Winnipeg St. Ry. Co. is stated to have been granted permission by the Town Council of St. Boniface to extend its line to Elm Park.

Windsor, Ont.—The Windsor, Essex & Lake Shore Rapid Ry. Co., with a capital of $1,000,000, is stated to have decided to construct a line from Windsor to Chatham. Wm. L. Wilson, of Port Huron, Pres.; John W. Goodson, of Detroit, Secy.; W. C. Crawford, of Tilbury, Ont., Treas., and Dr. Philip Heseltine, of Detroit, Gen. Mgr.

London, Ont.—The London St. Ry. Co. is reported to have been authorized by the City Council to construct a second belt line in South London.

RAILROADS.

Notes Arranged Alphabetically by States.

San Diego, Cal.—Jas. Allen, of San Diego, Asst. Engr. Bay Shore & Pacific R. R. Co., recently incorporated to construct a railroad in San Diego, writes that the probable cost of work is about $600,000. H. T. Richards, of San Diego, Ch. Engr.

Durango, Colo.—The Southern Pacific R. R. Co. (W. Hood, Ch. Engr., San Francisco, Cal.) is reported to have made a survey for a line from Durango into Canon City, and is now making a survey between Canon City and Denver.

**Denver, Colo.*—The Interstate Constr. Co., of Arizona, (Wm. H. Ward, Pres., Lowell, Mass.) is reported to have secured the contract for constructing an 800-mile line from Denver to Boise, via Yellowstone Park for the Colorado, Wyoming & Idaho R. R. Co.

Reidsville, Ga.—Geo. D. Mackey, of the firm of Mackey & Co., bankers, of New York, N. Y., is reported to have purchased the Reidsville & Glenville R. R. It is stated that the line will be extended to Vidalia, making a connection with the Darien & Western R. R.

Cordele, Ga.—A petition for a charter for the Cordele, Hawkinsville & Northeastern R. R. Co. has been filed by J. Pope Brown and C. W. Jordan, Jr., of Hawkinsville; B. P. O'Neal, R. L. Wilson and others of Cordele to construct a railroad from Cordele in a northeasterly direction to Tippettville, and from there directly to Hawkinsville; estimated length of road, 35 miles; capital, $300,000.

**Iowa Falls, Ia.*—R. A. Elzy, of Marshalltown, is stated to have secured the contract for building the extension of the Des Moines, Iowa Falls & Northern Ry. from Iowa Falls to Mason City, a distance of 55 miles.

South Omaha, Neb.—The Union Pacific R. R. Co. (J. B. Berry, Ch. Engr., Omaha) is reported to have decided to construct a cut-off from South Omaha to Elkhorn, a distance of 15 miles.

Newark, N. J.—There is reported to be some talk here of the Erie R. R. Co. (F. L. Stewart, Ch. Engr., New York, N. Y.) elevating its tracks in Newark.

Santa Fe, N. M.—The Northern New Mexico & Gulf R. R. Co. is reported incorporated, to construct a railroad from Santa Fe to Durango, Colo. Incorporators: G. Volney Howard, of Boulder, Colo.; Geo. Hill Howard of Santa Fe, and others.

**Lodi, O.*—Hoover & Kinnear, of Columbus, in connection with Reinhart, Dennis & Co., southern contractors, are reported to have secured the contract for the steam shovel and masonry work in constructing the cut off at Lodi for the Baltimore & Ohio R. R.; probable cost of work, $2,000,000.

Spartanburg, S. C.—The Spartanburg & Northern R. R. Co. is reported formed to construct a railroad between Spartanburg and Rutherfordton, a distance of 22 miles. Directors: J. C. Cleveland, R. K. Carson and others.

Madison, S. D.—The Chicago, Milwaukee & St. Paul Ry. Co. (D. J. Whittemore, Ch. Engr., Chicago, Ill.) is reported to have filed with the Secy. of State at Pierre a resolution of extension of its line of that system from Madison to Colton.

Dallas, Tex.—Press reports state that the Colorado & Southern R. R. Co. (H. W. Cowen, Ch. Engr., Denver, Colo.) will construct about 300 miles of road connecting with other roads into Dallas, Houston and Galveston. It is also reported to be considering the extension of the Cheyenne & Northern line to a point on the Canadian-Montana border, to be joined there by a branch of the Canadian Pacific.

Guadalajara, Mexico.—Press reports state that the Guadalajara & Armelia R. R. Co. is to be a steam road. It will be about 225 miles in length. M. C. Miller, promoter of the proposed road, is also reported to have secured another Federal concession for a line extending east from Guadalajara to San Miguel Altende. A separate company will be formed to build this line.

PUBLIC BUILDINGS.

Notes Arranged Alphabetically by States.

Prescott, Ariz.—Capt. Chas. C. Walcutt, Jr., Q. M., U. S. A., writes that all bids opened on Sept. 8 for the construction, plumbing, hot water heating and electric wiring of a hospital at Whipple Barracks were rejected. No date set for the receiving of new bids.

San Francisco, Cal.—The Wks. Bd., it is stated, is about to ask bids for the erection of an isolation hospital at 37 Ave and E. St. S., which is to cost about $25,000.

Madison, Ga.—Press reports state that bids will be received until Oct. 10 by the Bd. Co. Comrs. (K. S. Anderson, Chmn.) for $40,000 court house bonds.

**Galesburg, Ill.*—Davidson & Rundquist, it is stated, have secured the contract to erect the city hall at $34,000.

Illiopolis, Ill.—It is stated that the government contemplates erecting a hospital, costing $400,000, for the army and navy, on a site of 640 acres, which it has secured in Illipolis.

Princeton, Ind.—It is stated that Drs. Blair, Anderson and Ziliak are interested in the erection of a hospital here, and it is reported have ordered plans prepared for same.

**Muncie, Ind.*—Morrow & Morrow, of Muncie, have secured the contract for constructing complete the U. S. Post Office at Muncie, for $54,504.

**Huntington, Ind.*—The Huntington Light & Fuel Co., it is stated, has secured the contract to furnish the heat for the court house at $6,000 per year. W. H. Schott & Co., of Chicago, Ill., it is stated, have received the contract for the construction and installation of the interior heating, plumbing, ventilating and telephone conduit system in the new court house at $16,645.

Ft. Leavenworth, Kan.—Bids will be received until Oct. 27 by Capt. J. E. Normoyle, Q. M., U. S. A., for constructing 5 double sets of Lieutenants' quarters, including plumbing, heating and electric wiring at this post.

Louisville, Ky.—J. H. Cowles, Clk. Fiscal Court, writes that all bids opened Oct. 3 for heating and ventilating the new armory have been rejected.

**London, Ky.*—The Champion Iron Wks., of Kenton, O., it is stated, has secured the contract to erect the jail for Laurel Co., at $18,778.

**Annapolis, Md.*—The Noel Constr. Co., of Baltimore, it is stated, has secured the contract to erect the administration building at the Naval Academy at Annapolis at $59,000.

Baltimore, Md.—The following are the bids opened on Sept. 28 by the Superv. Archt., Treas. Dept., Washington, D. C., for the installation complete of the boiler plant, heating and ventilating apparatus for the U. S. Custom House at Baltimore: Downey & Hume Co., Milwaukee, Wis., $56,300; Crook & Horner Co., Baltimore, $49,721; Thompson Starret Co., New York, N. Y., $54,751; Gaylord & Eitapen Co., Binghamton, N. Y., $69,000; W. N. Tobin, Syracuse, N. Y., $56,400; E. Rutzler Co., New York, N. Y., $62,010; New York Steam Fitting Co., New York, N. Y., $59,972; C. H. Sanborn, Boston, Mass., $56,185; West End Htg. Co., Philadelphia, Pa., $64,235; Cleghorn Co., Boston, Mass., $44,877; J. McWilliams & Co., Louisville, Ky., $67,783; J. E. Granberry Co., Baltimore, Md., $46,372; L. Faith & Co., Philadelphia, Pa., $70,000, and T. M. Maguire, Minneapolis, Minn., $49,945.

Boston, Mass.—The Common Council, it is stated, passed an order appropriating $30,000 for the completion of the all-the-year-around bathhouse in Ward 6.

St. Paul, Minn.—The Bd. of Mgrs. of the State Fair, it is stated, have accepted the plans of Wm. M. Kenyon, of Minneapolis, for the livestock pavilion which is to be erected at the state fair grounds at a cost of $100,000. The building is to be of grey, cement covered brick, 200 x 350 ft., and it is stated that bids for the construction will probably soon be asked.

**Jefferson City, Mo.*—Geo. Todd, it is stated, has received the contract for furnishing brick for the new Supreme Court Bldg. at about $36,000.

Butte, Mont.—It is stated that the public library, which was destroyed by fire Sept. 24, will be rebuilt.

Overbrook, N. J.—Bids will be received until Oct. 30 by the Bldg. Com. of the Bd. of Chosen Freeholders at Newark (H. Gallagher, Chmn.) for erecting buildings at the branch hospital at Overbrook; cost about $1,200,000. Bids will be received for the work as a whole or separately on the following: Mason work; iron work and fireproofing; carpentry, roofing and sheet metal; tile and marble work; plumbing. Hurd & Sutton, Archts., Prudential Bldg., Newark.

Carmel, N. Y.—Bids will be received until Oct. 9 by John W. Towner, Clk. Bd. Superv., for alterations to the Putnam County jail and court house at Carmel. Bids are to be submitted for prison work, general construction and for plumbing, heating and lighting.

Ft. Wood, N. Y. Harbor.—Bids will be received until Oct. 18 by Traber Norman, Q. M., U. S. A., Governor's Island, for erecting a post hospital at Ft. Wood.

**Plattsburgh, N. Y.*—E. Prescott & Sons, of Keesville, it is stated, have secured the contract to erect buildings for the Clinton County Home, the hospital being omitted, at $50,640. Their bid including hospital, it is stated, was $60,640.

Lancaster, O.—Plans and specifications for the new market house, it is stated, have been received by the Bd. Pub. Service from Richards, McCarty & Bulford, Archts., of Columbus.

Scranton, Pa.—Mark K. Edgar, Dir. Dept. Pub. Safety, writes that bids will be received on Oct. 9 for erecting an addition to City Hall; probable cost, $50,000. Architect, F. L. Brown, Real Estate Exchange Bldg.

Harrisburg, Pa.—Bids will be received until Oct. 18 by Dr. H. L. Orth, Supt. Pennsylvania State Lunatic Hospital, for erecting a nurses' home and building for dangerous patients. J. A. Dempwolf, Archt., York. Also same date for erecting 2 temporary ward buildings for said hospital. Philip H. Johnson, Archt., Land Title Bldg., Philadelphia.

Burlington, Vt.—U. S. Senator Redfield Proctor, of Burlington, it is stated, has offered to furnish a site and erect a sanatorium for tuberculosis, to cost about $50,000, for the State of Vermont. Dr. W. H. Bryant, Secy. State Tuberculosis Comn.

Wausau, Wis.—Bids will be received until Oct. 16 by Mary M. Dickens, Secy. Free Public Library, for furnishing material and erecting a public library, including plumbing and heating.

Darlington, Wis.—It is reported that a court house costing $110,000 is to be erected here.

**Arcola, Man.*—The contract for the brick and carpenter work on the town hall, it is stated, has been awarded to J. H. Morrison ,of Arcola, at $10,850.

BUSINESS BUILDINGS.

Notes Arranged Alphabetically by States.

**Little Rock, Ark.*—Caldwell & Drake, of Columbus, Ind., it is stated, have secured the contract to erect the Hotel Marion at Markham and Louisiana Sts., the cost to be about $165,000.

A building permit has been issued to Jake Blass to erect a 3-story brick theatre building at 802 Main St., the cost to be about $20,000.

San Francisco, Cal.—It is stated that the Germans are considering the erection of a lodge hall which is to cost about $500,000.

Long Beach, Cal.—A. B. Benton, of Los Angeles, is reported to be preparing plans for a combined Y. M. C. A. and Y. W. C. A. building, to be erected at Long Beach, to cost about $20,000.

San Jose, Cal.—See "Electric Railways."

Los Angeles, Cal.—It is reported that plans are being prepared by A. L. Haley, Henne Bldg., and R. S. Saunders, for the erection of a 6-story commercial college and business block, to cost $125,000.

Denver, Colo.—Marean & Norton, Dodge Bldg., it is stated, are preparing plans for a 4-story brownstone business building which W. C. Mead, of the Denver Union Water Co., intends erecting at California and 16th Sts. at a cost of about $200,000.

Hartford, Conn.—H. C. Judd & Root, it is stated, will erect a garage at Allyn and High Sts. for S. A. Miner.

New Britain, Conn.—Plans are being completed for the construction of a $25,000 building on Church St. for O. F. Curtis.

**Wilmington, Del.*—Roydehouse-Arey Co., of Philadelphia, Pa., it is stated, have secured the contract to erect a brick passenger station at French and Front Sts. for the Pennsylvania R. R., the cost to be about $120,000.

Boise, Idaho.—J. E. Tourtellotte & Co., it is stated, are preparing plans for a building for the Idaho Savings & Trust Co., and it is reported that bids for the construction will soon be asked.

Chicago, Ill.—Building permits have been issued to the following: To Lambert Tree, to erect a 3-story brick store and office at 1972-80 W. Madison St., cost $50,000; Marquette Safety & Deposit Co., 17-story brick side addition to 103 Adams St., cost $155,000; Peter Bartsen, 1-story brick store, 1318 Ravenswood Park, cost $30,000; Albaugh Bros. Dyeing Co., 1-story brick dye house, 915-917 Marshall Boule., cost $30,000, and Thompson, Starrett Co., 12-story brick office building, 10-12 Madison St., cost $250,000.

A. T. Hawk, 6056 Monroe Ave., is preparing plans for an 11-stall roundhouse to be erected at 47th St. and Wentworth Ave. for the Chicago & Rock Island R. R., to be 1-story, 87 ft. deep, of brick, have gravel roof, and cost $20,000.

Terre Haute, Ind.—The Odd Fellows, it is stated, have selected a site at 7th and Cherry Sts., on which it is proposed erecting a 4-story building, to cost about $100,000.

Evansville, Ind.—Judge R. D. Richardson and John Spencer, it is reported, have purchased a site for the erection of a modern 8-story office building, to cost $200,000.

Des Moines, Ia.—Van Evera & Robinson, it is stated, have secured a site at W. 10th and Walnut Sts. and intend erecting a 3-story building, 80x132 ft.

**Owensboro, Ky.*—Walter Brachear, of Henderson, it is reported, has secured the contract to erect the depot here, at a cost of about $35,000.

Louisville, Ky.—The Sunny Brook Distillery Co., it is reported, have taken out a permit and intend erecting a 2-story brick warehouse, to cost $40,000.

**Items marked thus give the names of parties awarded contracts.*

New Orleans, La.—It is stated that the Consumers' Electric Co. will erect a 6-story office building on S. Rampart St.

Baltimore, Md.—A building permit has been granted to the A. S. Abell Estate to erect additional stories to the building at 222 E. Baltimore St., at a cost of about $32,000.

Sagamore Beach, Mass.—It is reported that L. D. Litchfield, of Boston, Mass., has prepared plans for a hotel to be erected here having 150 rooms. The building will be known as Sagamore Inn. N. H. Lathrop, manager.

Worcester, Mass.—Watson & Huckel, of New York, N. Y., and Philadelphia, Pa., it is reported, have prepared plans for a union passenger station which it is proposed erecting on Washington Sq. and Front St. at a cost of about $400,000. It is to be constructed either entirely of granite or of granite, brick and terra-cotta.

Fall River, Mass.—The Boys' Club, of Fall River, contemplates erecting a gymnasium; approximate cost about $15,000. Address Thos. Chew, Secy., Fall River.

Detroit, Mich.—Rogers & Macfarlane, 73 Moffat Bldg., are preparing plans for a 2-story brick building for the Animal Trap Co., in West Detroit. The size of the building is 40x45 ft and cost $25,000.

Hancock, Mich.—The Village Council, it is reported, has decided to purchase a driving park here on which a modern 4-story hotel is to be erected, to cost $50,000. A. J. Scott is a member of Council.

Minneapolis, Minn.—Edwin Murray, Pres. of the Murray Inst., it is stated, has secured a site and is having plans prepared by Kees & Colburn, 603 Kasota Bldg., for a sanitarium, which he proposes erecting at a cost of $30,000.

St. Louis, Mo.—The N. O. Nelson Mfg. Co., it is stated, has applied for a permit to erect a $150,000 warehouse at 914 Chestnut St., to be 8 stories high, 134x112 ft.

Helen M. Gould, it is reported, has agreed to give $150,000 for the erection of a 6-story brick and stone Y. M. C. A. building on Eugenia St.

Kansas City, Mo.—Judge C. E. Moss, owner of the site at 1016 Central St., it is reported, intends erecting a 3-story building on said site for the Kansas City Athletic Club, the cost to be about $40,000.

Excelsior Springs, Mo.—Dr. E. Lowrey, it is reported, has purchased a site and will erect a sanitarium in the northern part of the town, to cost $25,000.

Butte, Mont.—It is said to be the intention of the owners of the buildings destroyed by fire Sept. 24 to rebuild at once. The department store, owned by the N. Y. Realty Co., of which Harry Symons is vice-president, is one of the most important structures destroyed by fire.

Dillon, Mont.—It is stated that the erection of a theatre here, to cost about $20,000, is under consideration. C. S. Haire, of Helena, may be able to give further information.

Omaha, Neb.—A building permit has been granted to Dr. A. S. Wright to erect a 3-story store building at 314 N. 16th St., the cost to be $22,000.

**New York, N. Y.*—Plans have been filed for a 28-story R. R. office building which is to be erected on West St. between Cedar and Albany Sts. by the West St. Improv. Co. (Gen. Howard Carroll, Pres.). The John Peirce Co., 277 Bway., it is stated, has the contract for the construction. Probable cost, $2,000,000.

Springfield, O.—N. W. Fairbanks, it is reported, is interested in the erection of an 8-story office building and theatre on the site of the old Fountain Sq. Theatre.

**Mansfield, O.*—The Hill Constr. Co., of Pittsburg, Pa., it is stated, has been awarded the contract for the Pennsylvania R. R. shops at E. 1st St. at $150,000.

**Elyria, O.*—Fred Wolfe, of Elyria, it is stated, has secured the general contract for the Masonic Temple. The total cost of the building is to be about $65,000.

Cincinnati, O.—The Heuck Opera House Co., it is reported, has decided to erect a modern theatre on Vine St., opposite the Grand Opera House, to cost about $700,000. Jas. Fennessy is a member of the company.

**Lorain, O.*—P. Farrell, of Cincinnati, it is stated, has secured the contract to make terminal improvements in this city for the Baltimore & Ohio R. R., at a total cost of about $150,000. These improvements will consist of erecting a roundhouse, standard oil house, a building for offices, accommodations for the trainmen, etc., machine and blacksmith shops, etc.

Columbus, O.—It is stated that plans have been prepared for a 10-story office building, in which Frank Lane is interested, to be erected on Third St.

Portland, Ore.—It is reported that about Oct. 20 plans for the superstructure of the Wells-Fargo Bldg. will be ready for contractors. B. W. Morris, Archt., N. Y. City, N. Y.

*F. L. Litherland, 372 32d St., it is stated, has secured the contract for the brick, cement and iron work on the building to be erected at 7th and Morrison Sts., to be occupied by Tull & Gibbs, furniture dealers. It is stated that the building is to be 5 stories high, and the total cost to be about $100,000.

W. H. Moore, of the Moore Investment Co., it is stated, is interested in the erection of 5 brick warehouses, each 5 stories high, on a site bounded by Couch, 9th, Park and Hoyt Sts., in North Portland, the approximate total cost to be about $2,000,000.

Mahoningtown, Pa.—It is reported that a 3-story brick and stone passenger station and office building is to be erected on Ashland Ave. by the Baltimore & Ohio R. R. (D. D. Carothers, Ch. Engr., Baltimore, M.), the cost to be about $100,000.

**Philadelphia, Pa.*—Thos. Reilly, 1616 Thompson St., has secured a permit to erect a 3-story brick addition to 1523 Locust St., at a cost of $25,000.

Braddock, Pa.—W. A. Thomas, of Pittsburg, it is reported, has been engaged to prepare plans for a brick building for Morgan Bros., to cost $50,000.

Soho, Pa.—It is stated that bids are being received by S. Davis, of S. Davis & Co., Pres. of the Odd Fellows' Montefiore Hall Assoc., for the erection of the 4-story brick, stone and terra-cotta hall building which it is proposed erecting on 5th Ave. at a cost of about $60,000. Simeon Eisendrath, Farmers' Bank Bldg., Pittsburg, is the archt.

Pittsburg, Pa.—Robt. and Wm. A. Eisner, owners of the building at 5th and Wylie Sts., it is reported, have decided to remodel the same at a cost of about $25,000.

D. H. Burnham & Co., of Chicago, Ill., it is reported, have been selected to prepare plans for a 24-story hotel which is to be erected by H. C. Frick on the old Cathedral site.

It is reported that the South Side Warehouse & Terminal Co. will erect an annex to its building, costing $125,000.

**Newport, R. I.*—J. W. Bishop Co., of Worcester, Mass., it is stated, has received the contract to erect a trophy room and riding ring for Alfred Gwynne Vanderbilt at Oakland Farm, Newport, the cost to be about $125,000.

Columbus, S. C.—W. L. Morehead, of Columbus, S. C., it is reported, is Secy. of a Com. appointed by the Brotherhood of Ry. Trainmen, to select a site on which it is proposed erecting a home for the aged and disabled members, the cost to be about $100,000.

Knoxville, Tenn.—The Odd Fellows, it is reported, are considering the erection of a lodge hall, to cost about $12,000.

Nashville, Tenn.—Maj. E. B. Stahlman, it is stated, intends erecting a 12-story office building here, at Union St. and 3d Ave.

Ft. Worth, Tex.—The Elks Lodge, No. 124, it is stated, is contemplating the erection of a building at 6th and Rusk Sts. at a cost, including site, of about $40,000.

Spokane, Wash.—It is reported that 3 brick buildings in the wholesale and shipping dist. have been destroyed by fire, including the 2-story building of the Boothe-McClintock Co.

Bellingham, Wash.—It is reported that the Lodge of Elks is considering the erection of a lodge hall, to cost $10,000.

Ballard, Wash.—Dr. M. E. Cox, Pres. of the World's College of Therapeutics and the North Dakota Sanitarium, it is stated, is interested in a project to erect a natatorium and sanitarium at Spring Beach, 1 mile north of Ballard; probable total cost, $300,000. Dr. Henry Shaw, of Seattle, may be able to give further information.

Milwaukee, Wis.—Plans have been prepared for extensive improvements to the Colby & Abbot building. The plans include the addition of one story, making it a 6-story office building, and other improvements; total cost about $30,000.

A solid brick warehouse, 50x100 ft., is to be erected on Bway. between Chicago and Buffalo Sts., according to plans being prepared by Fred Graf, 307 Grand Ave. The building will be 4 stories high and cost $20,000.

New York, N. Y.

Allen and Delancy Sts., New York, N. Y., 6-story br. and stone store and tenemnt.; c, $50,000; o, J. Katz and M. Weinstein & Co.; a, E. A. Meyers.

164 Elm St., 6-story br. and stone stores and tenemt.; c, $25,000; o, Michael Briganti; a, Horenburger & Straub.

52 Norfolk St., 3-story br. and stone bank bldg.; c, $100,000; o, The State Bank; a, Herbert R. Mainzer and Edward Necarsulner.

Thompson and Broome Sts., 3 6-story br. and stone store and tenemt.; c, $100,000; o, Cohen & Kraft; a, M. Zipkes.

Plaza Sq. and 59th St., 18-story br. and stone hotel; c, $2,500,000; o, Plaza Operating Co.; a, H. J. Hardenbergh; b, Geo. A. Fuller Co., Fuller Bldg.

37 W. 17th St., 7-story br. and stone store and loft bldg.; c, $45,000; o, O. C. Olsen; a, C. A. French.

134 E. 18th St., 10-story br. and stone factory; c, $100,000; o, John S. Huyler; a, Schickel & Ditmars.

18 W. 21st St., 10-story br. and stone loft bldg.; c, $58,000; o, Jos. Robinson; a, C. Dunne.

11th Ave. and 34th St., 4-story br. and stone warehouse and stable; c, $85,000; o, Geo. J. Hoster; a, Henry Maetzel & Co.

Bway and 127th St., 3 6-story br. and stone stores and tenemts.; total c, $145,000; o, Arthur E. Silverman.

Decatur Ave. and Oliver St., 3-story br. studio; c, $25,000; o, Edison Mfg. Co.; a, Hugo Kafka & Sons.

Washington and Wendover Aves., 6-story br. stores and tenemt.; c, $45,000; o, Louis E. Kleban; a, Maximilian Zipkes.

Westchester and Tinton Ave., 5-story br. stores and tenemt.; c, $150,000; o, Wm. Oppenheim; a, Goldner & Goldberg.

CHURCHES AND DWELLINGS.

Notes Arranged Alphabetically by States.

Palo Alto, Cal.—The Bldg. Com., it is reported, has selected a site and is having plans prepared for a new edifice for the Presbyterian congregation, the cost to be about $25,000.

Denver, Colo.—Wagner & Manning, it is stated, have prepared plans for an 8-story white pressed brick apartment house which is to be erected on Sherman Ave., near Colfax Ave., by the heirs of the Lamson estate. Probable cost, $100,000. Mrs. John C. Newton, of Columbus, O., may be able to give further information.

The congregation of the South Logan Baptist Church, it is reported, contemplates erecting an edifice at S. Grant Ave. and Cedar St., to cost $25,000.

**Waynesboro, Ga.*—Englehart & Hitchcock, of Atlanta, it is stated, have secured the contract to install a hot water plant in the residence of Mrs. Willis Jones, at a cost of about $3,000.

Springfield, Ill.—Cram, Goodhue & Ferguson, of Boston, Mass., it is reported, have prepared plans for the Second Presbyterian Church, which is to cost about $65,000.

Chicago, Ill.—Building permits have been granted to the following: To M. J. Zollman, to erect a 3-story brick apartment at 2148-50 Kenmore Ave., to cost $20,000; H. W. Hagenberg, two 3-story brick apartments at 317-323 W. 57th St., cost $44,000; E. Pfennig, 3-story brick flat at 1664 Wellington St., cost $28,000; Louis Lagorrio, two 3-story brick flats at 1365-7 Madison St., cost $27,000; Geo. Morrison, 3-story brick apartment at 5630-32 Monroe Ave., cost $30,000; Nelson & Lewin, three 3-story brick apartments at 1199-1203-1205 Sheridan Road and 1421-23 Rokeby St., cost $60,000; Norman T. Cummings, 3-story brick apartment at 4628-40 Lake Ave., cost $30,000; Diversey Boule. Methodist Episcopal Church, 1-story brick church, 1317 Diversey Ave., cost $26,000; Martin C. Lordelius, 3-story brick apartment, 3636-3644 Ellis Park Ave., cost $35,000; E. Boyermann, three 3-story brick flats, 1628-1632 Addison St., cost $25,000, and J. Loewenstein, 3-story brick apartments at 6800-04 Halsted St., and 905-11 68th St., cost $40,000.

Bishop & Co. have prepared plans for and it is stated will receive bids for an apartment building to be built at 2115 Sheridan Road for Frank A. Kearns. It will be 3 stories, 43x72½ ft., pressed brick and stone, and cost $26,000.

Jos. Molitor, Archt., 160 Washington St., it is stated, will receive bids for a church and school building to be built at 18th and Allport Sts. for St. Procoplus R. C. congregation. It will be 4 stories, 60x115 ft., of fireproof construction, pressed brick and stone, and slate roof, steam heat, and cost approximately $100,000.

Hartford City, Ind.—It is reported that the Presbyterian Church on N. High St. is to be rebuilt at a cost of $15,000. Harry Hill, Trus.

Bermidji, Minn.—The Advisory Com. of the St. Philip's R. C. Church, it is stated, has decided to have plans prepared for a church and residenece to be erected at Beltrami Ave. and 7th St., the total cost to be about $25,000.

Minneapolis, Minn.—Reed & Stem, Endicott Bldg., St. Paul, it is reported, have prepared plans for a residence to be erected at 2327 Pillsbury Ave. for F. N. Osborn, the cost to be about $35,000.

Kansas City, Mo.—C. A. Smith, Dwight Bldg., has prepared plans for a brick dwelling for Jerome Bernheimer, to be erected at 3434 Pasco St., to cost $18,000.

Bozemon, Mont.—E. W. King, it is reported, has had plans prepared by Keith Co., of Minneapolis, Minn., for a $15,000 brick residence.

Lincoln, Neb.—It is reported that the Christian Scientists of this city are to erect a church to cost $75,000.

Long Branch, N. J.—A 3-story brick apartment house, it is stated, is to be erected here by Thos. McKenna, at a cost of $30,000.

Rochester, N. Y.—The Polish Catholics of the pastorate of Rev. T. Szadzinzski, it is reported, have voted to erect a new church, to cost $50,000. Vincent Wagner is Secy. Bldg. Com.

Sycamore, O.—The members of the Reformed Church, it is stated, intend erecting a limestone edifice, to cost $15,000.

**Pittsburg, Pa.*—Archt. H. S. Estep, 209 9th St., it is reported, has let the contract to D. A. File for the erection of a 3-story brick apartment building, to cost $21,000.

Philadelphia, Pa.—It is reported that plans have been prepared by C. E. Schermerhorn, 430 Walnut St., for a $60,000 residence, which is to be erected for C. Howard Schermerhorn.

*Alex. Chambley, 707 Walnut St., it is stated, has secured the contract to erect an edifice for the Lutheran Church of the Incarnation at 47th St. and Cedar Ave., the cost to be about $35,000.

**Spokane, Wash.*—Hastie & Dougan, of Spokane, it is stated, have received the contract to erect the First Baptist Church at $45,000.

Milwaukee, Wis.—Robt. Nunnemacher, it is stated, intends erecting a residence on Wahl Ave. to cost about $75,000.

New York, N. Y.

160 Waverly Pl., 6-story br. and stone tenemts.; c, $40,000; o, Paul Hoffmann; a, Kurtzer & Rentz.

202 E. 7th St., 6-story br. and stone tenemt.; c, $25,000; o, Rockmore & Gleich; a, Harry Zlot.

321 E. 31st St., 6-story br. and stone tenemts.; total c, $180,000; o, Phipps Houses; a, G. Aterbury.

82d St. and Ave. B, 2 6-story br. and stone tenemts.; total c, $80,000; o, Frederick H. Nadler; a, Stern & Morris.

119th St. and 7th Ave., 2 6-story br. and stone tenemts.; total c, $60,000; o, Moses S. Shill; a, Horenburger & Straub.

Riverside Drive and 92d St., 9-story br. and stone apartment house; c, $350,000; o, West Side Constr. Co.; a, Geo. F. Pelham.

113th St. and Lenox Ave., 4-story br. and stone dwell.; c, $20,000; o, Samuel Mandel; a, Rouse & Sloan.

133d St. and 5th Ave., 6-story br. and stone tenemt.; c, $50,000; o, Levinson & Greenfield; a, Bernstein & Bernstein.

135th St. and Bway, 11 5-story br. and stone tenemts.; total c, $385,000; o, D. L. Block Co.; a, Wm. C. Sommerfeld.

139th St. and Bway, 2 5-story br. and stone tenemts.; total c, $125,000; o, The Lawrenze Bldg. Co.; a, Rudolf Werner.

148th St. and Convent Ave., 6-story br. and stone tenemt.; c, $100,000; o, Chas. Brogan; a, Neville & Bagge.

172d St. and Amsterdam Ave., 4 5-story br. and stone tenemts.; total c, $160,000; o, London & Meryash; a, Horenburger & Straub.

Claremont Ave. and 127th St., 6-story br. and stone tenemt.; c, $80,000; o, Chas. and Geo. Hensle; a, Glasser & Ebert.

Claremont Ave. and 127th St., 6-story br. and stone tenemt.; c, $150,000; o, John V. Signell Co.; a, Neville & Bagge.

Riverside Drive and 137th St., 6-story br. and stone apartment; c, $150,000; o, Transit Realty Co.; a, Moore & Landsiedel.

135th St. and St. Anns Ave., 3 6-story br. tenemts.; total c, $105,000; o, David Zipkin; a, Samuel Sass.

162d St. and Prospect Ave., 5-story br. tenemt.; c, $40,000; o, McCarthy & Macy; a, Moore & Landsiedel.

Villa Ave. and 200th St., 4-story br. tenemt.; c, $20,000; o, Antoinetta Jingliano; a, Chas. S. Clark.

Webster Ave. and 180th St., 5-story br. tenemt.; c, $50,000; o, Koelsch Huebner Co.; a, Harry T. Howell.

Wendover and Washington Aves., 2 6-story br. tenemts.; total c, $80,000; o, Louis E. Kleban; a, Maximilian Zipkes.

325 E. Houston St., 6-story br. and stone tenemt.; c, $25,000; a, Geo. L. Wiss, 1 Union Sq.

SCHOOLS.

Notes Arranged Alphabetically by States.

Chicago, Ill.—See "Churches and Dwellings."

Chicago, Ill.—Wm. J. Brinkmann, 165 Randolph St., it is stated, is about to let contracts for a school which will be

**Items marked thus give the names of parties awarded contracts.*

built at 63d and 64th Sts., Claremont and Oakley Aves. for the Church of St. Rita of Cascia. The building will be 3 stories, of pressed brick and stone, and cost probably $40,000.

**Evanston, Ill.*—Henry W. Schlueter, of Chicago, it is stated, has secured the general contract for the David B. Dewey School to be built at Grove St. and Wesley Ave. It will be 2 stories, 80x140 ft., of brick, stone and terracotta, have slate roof, steam heat, electric wiring for light, and cost $55,000. Phillips, Rogers & Woodyatt are the architects.

**Brazil, Ind.*—Miller & Carter, of Eldorado, Ill., it it reported, have secured the contract to erect a school for the Annunciation parish at $10,100.

Ft. Gibson, Ind. Ter.—The citizens, it is stated, have agreed to erect a school for the deaf, dumb and blind, the cost to be about $10,000.

Cedar Falls, Ia.—The Trus. of the Iowa State Normal School have, it is stated, adopted the plans of Proudfoot & Bird, of Des Moines, for the chemical laboratory, to cost $50,000. The building will be 3 stories and basement.

Louisville, Ky.—It is stated that bids are wanted until Oct. 16 for erecting a building for the Presbyterian Theological Seminary, to be equipped with steam heating plant (low pressure) and cost $75,000. For further particulars address Kenneth McDonald and W. J. Dodd, Archts., Louisville.

**Tufts College, Mass.*—Richardson & Burgess, of Washington, D. C., it is reported, have secured the contract for the foundation for the Carnegie Library to be erected at Tufts College.

Haverhill, Mass.—The city contemplates erecting wings to the present high school; estimated cost, $150,000; architect not yet selected.

Kansas City, Mo.—It is reported that plans are being prepared for a parochial school for St. Vincent's R. C. Church, to cost about $50,000. Rev. Father Antuel, pastor.

Jersey City, N. J.—Bids will be received until Oct. 12 by the Bd. Educ. (Fred. Ege, Sec'y), for furnishing material and making alterations and extensions to School No. 27, to consist of carpenter work.

East Orange, N. J.—The Bd. of School Estimate, it is stated, has approved the plans for the school which is to be erected on Park Ave., in the Ashland Dist.

Orange, N. J.—The Bldg. Com. of the Bd. of Educ. on Sept. 29, it is stated, adopted a resolution to reject the plans for the Central High School and to have new plans prepared. They also decided to reject the bids recently received for this work. Edw. D. Hale, of New York, N. Y., is to prepare new plans for a school, to cost about $100,000.

New York, N. Y.—The Bd. of Estimate has approved the appropriation of $3,000,000 for the use of the Bd. of Educ. for the purchase of sites for schools; also $25,000 to purchase an athletic field in Richmond Boro. for the school athletes.

Bids will be received by C. B. J. Snyder, Supt. School Bldgs., New York City, until Oct. 16, for installing, ventilating and heating apparatus for additions to and alterations in School 10; building walls and laying artificial stone pavements at School 9, both in Boro Bronx; also installing ventilating and heating apparatus and electric bells in temporary school 7; machinery and fittings for shops, etc., School 25; both in Boro. Manhattan.

*The following are the bids opened on Oct. 2 by C. B. J. Snyder, Supt. School Bldgs., for general construction, etc., of additions to and alterations in School 25, Boro. of Manhattan: Joseph Ohlhausen, $23,823; Thos. Cockerill & Son, $24,000; Patk. Sullivan, $24,440; Wm. Werner, $24,835; Thos. McKeown, $23,323; Laurence J. Rice, 398 Bway., $21,926 (awarded contract); Chas. H. Peckworth, $24,325; J. & L. Moreland Co., $23,325.

All bids opened on Oct. 2 for additions to and alterations in School 158, Manhattan Boro., have been rejected and new bids will be received by C. B. J. Snyder, Supt. School Bldgs., until Oct. 16. The following are the bids received for this work on Oct. 2: Wm. Werner, $66,765; Alfred Nugent's Son, $69,790; Thos. Cockerill & Son, $74,900; Patk. Sullivan, $68,600, and Chas. H. Peckworth. $58,967.

Bids will be received until Oct. 16 by C. B. J. Snyder, Supt. School Bldgs., for the general construction, etc., of School 4, Boro. Manhattan.

Brooklyn, N. Y.—The following are the bids opened on Oct. 2 by C. B. J. Snyder, Supt. School Bldgs., N. Y. City, for general construction, etc., of Eastern District High School, Brooklyn Boro.: F. W. Carlin Constr. Co., $573,648; Juan B. Arci, $513,000; John Auer & Sons, $528,800; Richard E. Heningham, $514,450; Thos. Cockerill & Son, $537,777; John Kennedy & Son, $485,000; P. J. Walsh, $400,990; P. J. Brennan, $539,000; Peter Cleary, $523,873; Buckley Realty Constr. Co., $560,000; Clarke & Stowe, $496,300, and Chas. H. Peckworth, $519,985.

Youngstown, O.—Bids will be received until Oct. 26 by the Bd. Educ. (W. N. Ashbaugh, Clk.), for furnishing material and erecting a 10-room brick and stone school on Myrtle Ave.

Cincinnati, O.—Press reports state that bids will be received until Oct. 16 by Wm. Grantman, Clk., Bd. Educ., for $150,000 bonds.

Lancaster, O.—Bids will be received until Oct. 30 by the Bd. Trus. of the Boys' Industrial School (C. B. Adams, Secy.) for furnishing material and erecting a dairy barn for said institution. Richards, McCarthy & Bulford, Archts., Columbus.

**Barnesville, O.*—A contract has been awarded to Robt. H. Evans & Co., of Zanesville, according to reports, for the erection of a high school to cost $45,000.

Winchester, Tenn.—The erection of a county high school here is reported under consideration.

Chelan, Wash.—The citizens are reported to have voted in favor of erecting a school at a cost of $10,000.

**Charleston, W. Va.*—Holbert & Spedden, of Fairmont, it is stated, have been awarded the contract for the construction of a dormitory at the State Normal School, at $14,000.

**Fairmont, W. Va.*—It is reported that the Bd. of Educ. has let the contract for the construction of the Central High School to Spedden & Holbert at $59,327.

Platteville, Wis.—Bids will be received until Oct. 26 by the Bd. Regents of Normal Schools of Wisconsin at Madison, for erecting a normal school at Platteville. Separate bids to be submitted for the steam heating and plumbing. Probable cost, $120,000. Van Ryn & De Gelleke, Archts., Milwaukee; Freeman H. Lord, Chmn. Executive Com.

Horicon, Wis.—Van Ryn & De Gelleke, of Milwaukee, are preparing working plans for a 2-story brick high school, which, it is stated, is to be erected at Horicon, at a cost of $20,000.

**Appleton, Wis.*—Hinkley & Powers, of Green Bay, Wis., it is reported, have been awarded the contract for the erection of a brick school on the Oneida reservation to cost $10,738.

La Crosse, Wis.—A dormitory is to be erected at Gale College which is to cost about $15,000.

STREET CLEANING AND GARBAGE DISPOSAL.

Notes Arranged Alphabetically by States.

Minneapolis, Minn.—Andrew Rinker, City Engr., writes that temporary repairs, to cost $2,500, are to be made to the garbage crematory recently burned, the work to be done under direction of the City Engr. A new plant will probably be constructed next year.

Brooklyn, N. Y.—The following are the bids opened on Oct. 3 at the office of the Dept. of Street Cleaning, N. Y. City, for the removal of snow and ice in the Boro. of Brooklyn (price given per cu. yd.), bidders of Brooklyn unless otherwise mentioned: Wm. Bradley, 320 W. 86th St., N. Y. City, 27 cts.; Donlan Contr. Co., 84 Bway, Brooklyn, 27 cts.; Chas. Hart, 4th Ave. and De Graw St., 36 cts.; O'Grady Bros., 78 N. 8th St., 36 cts.; Hill & Hayes, 165 Rutger St., 45 cts.; M. T. Maher, 125 Hope St., 40 cts.; John T. Mailee, 1247 Prospect Pl., 33 cts.; Bracken Macaveney, 67th St., Bay Ridge, 33¼ cts.; McDermott & Foxton, E. New York and Rochester Aves., 38 cts.; Haley & Keegan, 50 Dobbin St., 42 cts.; Chas. Cranford, 44 Court St., 33½ cts.; Norton & Gorman, 303 Douglas St., 33½ cts.; T. Donovan & Son, 504 Union St., 42 cts; M. F. Hickey, 2d Ave. and 6th St., 70 cts.; Bofri & Ahearn, 65 cts.

Columbus, O.—Rudolph Hering, of New York, N. Y., is reported to have recommended the construction of a general garbage crematory, at which both garbage and general rubbish may be consumed. Estimated cost of such a plant should be about $100,000 or $125,000. He suggests that if it is deemed impracticable to collect the general rubbish in connection with the garbage, the city erect a reduction plant. The Council is reported to have adopted a resolution calling on the Bd. of Pub. Service to prepare plans for a garbage crematory.

**Sherman, Tex.*—Chas. E. Hayden, City Engr., writes that the contract for a street sweeping machine (bids opened Sept. 18) has been awarded to the Austen Western Co., Ltd., of Dallas.

NEW INDUSTRIAL PLANTS.

See also Business Buildings.

Tenders will be received until Oct. 10, for the erection of a brick and reinforced concrete factory at Toronto, Ont. Plans and specifications can be seen and all other information obtained at office of the architect, E. J. Lennox, 164 Bay St., Toronto.

G. H. Smith, Arnoldsville, Ga., is interested in the erection of a steam laundry plant, to be equipped with latest improved machinery.

Biddle & Ellsworth, Ltd., Johnson City, Tenn., will rebuild their milling plant recently burned. Plans not yet determined upon.

Plymouth Cordage Co., North Plymouth, Mass., is preparing plans for the erection of a plant at Welland, Ont.

Rogers Boiler & Burner Co., Muskegon, Mich., have begun the erection of a new shop, 150x50 ft.

A. W. Peet, Kansas City, Mo., is interested in the erection of a cotton mill. Plans not definitely determined.

F. E. Glenn, St. Charles, Ill., will shortly begin the erection of a large foundry to be operated in connection with his present plant, acording to local newspaper reports.

The Pacific Coast Gypsum Co., Tacoma, Wash., will erect a large plaster mill, to cost $60,000, according to local newspaper reports.

H. A. Peterson Mfg. Co., Chicago, Ill., mfrs. of architectural iron work, etc., is erecting a brick, stone and concrete building, 125x75 ft., to be equipped for the manufacture of conduit.

Bucyrus (O.) Steel Casting Co. is planning to erect a steel foundry building, 130x300 ft., which will be completely equipped with latest improvements.

The Mechanical Appliance Co., Milwaukee, Wis., will erect a 2-story addition to present plant, to measure 82x210 ft. This company is in the market for a 50-h.p. gas engine and 35-k.w. generator.

Flour City Ornamental Iron Works, Minneapolis, Minn., will build a 2-story brick addition to present plant, to measure 75x300 ft. New power plant and other machinery will be installed.

Matheson Motor Car Co., Holyoke, Mass., will shortly begin the erection of a new plant at Wilkes-Barre, Pa. Main building will measure 80x600 ft. In addition to this will be an engine room and blacksmith shop.

The Braughton Mantel Mfg. Co., Memphis, Tenn., has recently been organized for the manufacture of cabinet mantels and light furniture. Site has been acquired for a new plant to consist of main building, 50x122 ft., 2 stories, wareroom 50x70 ft., together with dry kilns, etc. 90-h.p. boiler and 70-h.p. engine will be installed.

Finney Mfg. Co., Dyersburg, Tenn., will erect a new plant for the manufacture of mantels and other furniture. New factory will measure 120x80 ft., and will be equipped with 45-h.p. power plant, together with planer, saws, etc.

C. C. Bass & Co., Rome, Ga., have organized a new fertilizer and cotton oil company, and are preparing to erect a plant which will measure 80x120 ft.

D. A. Phelps, Poulan, Ga., is contemplating the installation of a 6-ton ice making plant.

American Cast-Iron Pipe Co., Birmingham, Ala., is about to begin the erection of a pipe foundry plant having a capacity of 150 to 200 tons per day. Plans are being prepared for jib and traveling cranes and other special machinery that will be required.

Weaver Coal & Coke Co., Chicago, Ill., will erect large plants in the Latana District, near Crossville, Tenn. The new plants will handle about 2,000 tons of coal per day. This company will also establish a coking plant at Daddy's Creek Bend, near Ozone, Tenn.

Unity Cotton Mills, La Grange, Ga., will shortly begin the erection of a new mill measuring 102x400 ft., 2 stories high. Power plant with a capacity of 750 h.p. will be required.

The Morrison-Miles Lumber Co., recently organized in Lynchburg, Va., has purchased a large tract of timber near that place, consisting of poplar, white and red oak, chestnut, hickory and gum. A new plant will be established, and the company is in the market for saw mills, engines and boilers. This company is open to propositions from saw mill men for sawing up part of the boundary of above tract.

The Kenworthy Engineering Co., engineers, Waterbury, Conn., will erect a new plant for the Wallingford Metal Co., Waterbury, Conn., consisting of main building, 160x160 ft., 1 story; casting shop, 100x160 ft., 1 story, and boiler house, 45x50 ft.

The Oscar Lear Automobile Co., Columbus, O., is preparing plans for an extensive addition to its present plant, according to local newspaper reports.

The Tennessee Marble Co., Knoxville, Tenn., will erect a new marble plant, to cost $25,000, according to local newspaper reports.

MISCELLANEOUS.

Notes Arranged Alphabetically by States.

Washington, D. C.—See "Power Plants, Gas and Electricity."

Washington, D. C.—Bids will be received by Lieut. Col. R. L. Hoxie, Corps Engrs., U. S. A., until Oct. 30 for dredging in Potomac River near Washington; also on Nov. 1 for constructing jetty at Carters Creek, Va., both advertised in The Engineering Record.

Bids will be received at the office of Chief of Engrs., U. S. A., War Dept., Washington, until Nov. 3, for furnishing and delivering chain ammunition hoists, as advertised in The Engineering Record.

Wilmington, Del.—Capt. C. A. Flagler, Corps Engrs., U. S. A., is reported to have received from the War Dept. at Washington, D. C., permission to increase the depth of Smyra River from 6 to 7 ft.; he also received the approval of the contract for making the cut-off in Appoquinimink River at Fennimore's Bridge. As a result of this improvement it will be necessary for New Castle County to construct a new bridge at Fennimore's.

Pensacola, Fla.—Bids will be received until Oct. 24 at the Bureau Supplies and Accounts, Navy Dept., Washington, D. C., to furnish at the Navy Yard, Pensacola, a quantity of Naval Supplies, including galvanized sheet steel, ingot copper, bolts and nuts, creosoted railroad ties, etc. H. T. B. Harris, Paymaster Gen., U. S. N.

Chicago, Ill.—The West Park Bd. is reported to have authorized its engineer to prepare plans for a subway at 17th St. under the three trunk lines, the Pennsylvania, the Terminal & Transfer R. R. and the Chicago Junction R. R.

Crownpoint, Ind.—Joshua P. Spalding, County Drainage Comr., writes that only preliminary work has as yet been done in connection with the proposed construction of a drainage canal through the Calumet regions; probable cost, $65,000. This matter will come before the court at the November term, and bids will not be called for before January. Wm. F. Bridge, Co. Surv., Hammond, Ind.

Marion, Ind.—It is reported that bids will soon be asked by the Bd. of Pub. Wks. for the construction of a levee along the east line of Sweitzer St.

Greenfield, Ind.—The committee in charge of straightening Brandywine Creek will probably be ready to report Nov. 25; cost of proposed work about $35,000. O. H. Monger, Co. Surveyor.

**Des Moines, Ia.*—Lew Burnett, Co. Aud., writes that the contract for constructing a ditch, about 47,000 cu. yd. (bids opened Sept. 23), has been awarded to O. P. Herrick, of Des Moines, at 18⅞ cts. per cu. yd.

Boston, Mass.—The following are the bids opened on Sept. 30 by the Bureau of Yards and Docks, Navy Dept., Washington, D. C., for extension of track for locomotive crane, Navy Yard, Boston (bidders all of Boston): Wm. L. Miller, 19 Milk St., $28,339; C. M. Leach, Navy Yard, $22,500; W. H. Ellis, 17 Milk St., $23,790, and T. H. Gill & Co., 88 Broad St., $24,440.

**Corunna, Mich.*—The Canal Constr. Co., of Chicago, Ill., is reported to have secured the contract for dredging 22 miles in Shrawasse and Clinton counties for $46,393.

Moorhead, Minn.—It is stated that bids will be received until Oct. 19 by John Eid, Co. Aud., for constructing ditch No. 3 in sections of 100 ft. It approximates as follows: Main ditch 44,500 ft long, 95,464 cu. yds., est. cost, $9,546. It is stated that bids will also be received for ditch No. 2, approximating 29,700 ft. long, 90,376 cu. yds.; branch 7,965 ft. long, 9,172 cu. yds., estimated cost $9,954.

Olivia, Minn.—It is stated that bids will be received until Oct. 16 by H. J. Lee, Co. Aud., for constructing ditch No. 22, approximately 70,607 cu. yds., and estimated to cost $8,826.

Portsmouth, N. H.—Bids will be received until Oct. 28 by Mordecai T. Endicott, Ch. Bureau Yards and Docks, Navy Dept., Washington, D. C., for removing earth and rock at the Navy Yard, Portsmouth.

New York, N. Y.—Bids will be received by Col. W. R. Livermore, Corps Engrs., U. S. A., Army Bldg., until Oct. 17, for dredging in Raritan, South and Shrewsbury Rivers, N. J., and channel between Staten Island and New Jersey, as advertised in The Engineering Record.

Bids will be received until Oct. 11 by Nicholas J. Hayes, Fire Comr., for furnishing material, for repairs, alterations and additions to fire alarm telegraph system in Boro. Manhattan.

*The contract for constructing a pier at E. 120th St. (bids opened Sept. 29 by the Dept. of Docks and Ferries) has been awarded to Augustin Walsh, 96 Water St., for $9,300.

*Bernard Rolf, 39 Cortlandt St., on Oct. 2 received the contract from the Dept. of Docks for constructing a pier on North River and 42d St., for $110,723.

Long Island City, L. I., N. Y.—The following are the bids opened on Oct. 2 by C. B. J. Snyder, Supt. School Bldgs., N. Y. City, for constructing retaining walls, etc.,

Items marked thus give the names of parties awarded contracts.

at School 4, Queens Boro.: Geo. H. Waters, $3,890; Alfred Nugent's Son, $4,190, and Matthew J. Crowley, $4,229.

Albany, N. Y.—Senator George R. Malby and Paul Smith, Jr., in behalf of the Supervisors of Franklin, St. Armand and Black Brook, are stated to have petitioned the State River Improvement Comn. to authorize the construction of two dams across the Saranac River. The application involves the principle of flooding State lands under the consent of the River Comn. The petition declares that by the overflow of Saranac the sewage from Saranac Lake Village, which empties into the river, is thrown upon the banks, and when it dries it is injurious to health. It is estimated that 400 acres of State land will be flooded and the expense of the proposed improvement will be about $500,000. In the petition it is further stated that the Paul Smith's Electric Light & Power Co. desires to build a dam at Franklin Falls to generate electricity and that it will erect a dam there and at Union Falls without expense to the State. The towns presenting the petition employed Engr. Elmer Merrill, who reported that dams at Franklin Falls and Union Falls would regulate the flow of the river and correct the conditions complained of.

Lincoln, Neb.—Bids will be received by the Superv. Archt., Treas. Dept., Washington, D. C., until Oct. 23, for a vacuum cleaning system for the U. S. Court House and Post Office building at Lincoln, Neb., as advertised in The Engineering Record.

**Columbus, O.*—D. E. Sullivan & Son, of Columbus, secured the contract for the excavation of 200,000 cu. yds. of earth and silt of the Ohio Canal between Cleveland and Akron, at 15 cts. and 14 cts. per cu. yd.; bids opened Oct. 3 by the State Bd. of Pub. Wks. (Saml. Bachtell, Asst. Engr.).

Panama.—See "Water."

Panama.—Bids were opened on Oct. 4 by the Isthmian Canal Comn., Washington, D. C., for furnishing the following: 800 wooden or steel flat cars: (*a*) steel, (*b*) wooden (price given for each): Standard Steel Car Co., Pittsburg, Pa., (*a*) $1,265 (80,000 capacity), and (*a*) $1,300 (100,000 capacity), erected at City of Colon. Pressed Steel Car Co., New York, N. Y., *a* $1,295 (80,000 capacity), *a* $1,370 (100,000 capacity), erected at Colon. American Car & Fdy. Co., New York, N. Y., *b* $1,044 and with modifications, *b* $997 (erected at Colon). Seattle Car Co., Seattle, Wash., *b* $980 (erected at La Boca). J. K. Joice, Chicago, Ill., $1,149.

The Marion Steel Shovel Co., of Marion, O., bid for unloading plows, $900 ea.

For 19 seventy-ton steam shovels, all to be erected at Colon, price given for each: Marion Steam Shovel Co., Marion, $10,450; Atlantic Equipment Co., New York, N. Y., $11,750; Allis-Chalmers Co., New York, N. Y., $9,400; Bucyrus Co., So. Milwaukee, Wis., $10,240; Lidgerwood Mfg. Co., New York, N. Y,. $7,940.

Norfolk, Va.—The following are the bids opened on Oct. 3 by the Bureau of Supplies and Accounts, Washington, D. C., for (*a*) dredging 10,000 cu. yds. mud, etc., at Navy Yard, Norfolk, (*b*) removal of old timber crib: Coastwise Dredging Co., Norfolk, *a* $2,300, *b* $1,200. Norfolk Dredging Co., Norfolk, Va., *a* $2,500, *b* $700.

**Wheeling, W. Va.*—The following are the bids opened on Sept. 22 by Maj. Geo. A. Zinn, Corps Engrs., U. S. A., for furnishing and delivering 49 steel trestles for dams on Kanawha River (price given per lb.): Frank Woodman, Charleston, W. Va., 5.66 cts.; J. & J. B. Milholland Co., Pittsburg, Pa., 6.3 cts.; Griffiths Iron Works Co., St. Louis, Mo., 5.7 cts.; Lawrence D. Weaning, Cleveland, O., 6.5 cts.; The Interstate Eng. Co., Bedford, O., 6.49 cts.; The Wm. Bayley Co., Springfield, O., 6.9 cts.; Geo. C. Thomas. New York, N. Y., 6.8 cts.; The North Penn Iron Co., North Penn Junction, Philadelphia, Pa., 6.25 cts.; New Jersey Fdry. & Machine Co., New York, N. Y., 6.97 cts.; Chas. Hegewald Co., New Albany, Ind., 5.25 cts.; Penn Bridge Co., Beaver Falls, Pa., 6.4 cts.; The Champion Iron Co., Kenton, O., 3.67 cts. (awarded contract).

Ashland, Wis.—The Chicago & Northwestern R. R. Co. is reported to have decided to construct an ore dock here, at a probable cost of $600,000. L. N. Costley, Asst. Div. Supt., Ashland.

PROPOSALS OPEN

For Proposals see pages 72, 76 and 79

WATER WORKS.

Bids Close.		See Eng. Record.
Oct. 10.	Basins, etc., Toledo, O. Adv. Sep. 16 to Sep. 30.	Sep. 16
Oct. 10.	Reservoirs, St. Louis, Mo	Sep. 30
Oct. 10.	Water Wks., Jacksonville, Tex	Sep. 30
Oct. 11.	Pipe and specials, Portland, Ore Adv. Sep. 16 to Sep. 23.	Sep. 16
Oct. 11.	Water mains, Portland, Ore Adv. Sep. 16 to Sep. 23.	Sep. 16
Oct. 11.	C. I. pipe, etc., Williamsburg, Pa	Sep. 23
Oct. 11.	Main, etc., Brooklyn, N. Y	Sep. 30
Oct. 11.	Mains, New York, N. Y	Sep. 30
Oct. 11.	Reservoir, Annapolis, Md	Sep. 30
Oct. 12.	**Sale of standpipe, Attleboro, Mass** **Adv. Jul. 29 to Aug. 5.**	**Jul. 29**
Oct. 12.	Water wks., Lyon Falls, N. Y Adv. Sept. 30 to Oct. 7.	Sep. 30
Oct. 12.	Water wks., Pleasant Grove, Utah Adv. Sep. 30.	Sep. 30
Oct. 13.	C. I. pipe, etc., Cincinnati, O	Sep. 23
Oct. 13.	Filter sand and gravel, Cincinnati, O	Sep. 23
Oct. 13.	Stand pipe, Grand Rapids, Mich Adv. Oct. 7.	Oct. 7
Oct. 13.	Water towers, etc., Panama	Oct. 7
Oct. 14.	Pipe, Waynesville, N. C.	Oct. 7
Oct. 16.	System, Rolla, Mo.	Sep. 16
Oct. 16.	Water wks., Leesburg, O.	Sep. 30
Oct. 16.	Pipe, Los Angeles, Cal Adv. Oct. 7.	Oct. 7
Oct. 16.	Pumps, etc., Panama	Oct. 7
Oct. 17.	**Embankment, Roswell, N. M** **Adv. Aug. 26 to Sep. 30.**	**Aug. 26**
Oct. 18.	**Water Wks., Milledgeville, Ga** **Adv. Sep. 9 to Sep. 30.**	**Sep. 9**
Oct. 18.	**Mains, Boulder, Colo.** **Adv. Sep. 16 to Oct. 7.**	**Sep. 16**
Oct. 18.	Tank, etc., Perrysburg, O.	Oct. 7
Oct. 19.	Wells, Ft. Ethan Allen, Vt Adv. Sept. 30 to Oct. 7.	Sep. 30
Oct. 20.	System, Minooka, Ill.	Oct. 7
Oct. 21.	Well, New Orleans, La	Sep. 30
Oct. 24.	System, Ciudad Juarez, Mex	Sep. 16
Oct. 26.	Dams, canals, etc., Belle Fourche, S. D. Adv. Sept. 2 to Oct. 7.	Sep. 2
Oct. 28.	Canals, etc., Hood River, Ore	Oct. 7
Nov. 1.	Water wks., Waverly, Minn	Sep. 23
Nov. 15.	Canals, etc., Buford, N. D Adv. Sept. 30 to Oct. 7.	Sep. 30
Dec. 5.	Dam, Glendive, Mont. Adv. Sep. 16 to Oct. 7.	Sep. 16
Jan. 1.	Irrig. work, El Campo, Tex	Oct. 7
Jan. 2.	Water wks., Manila, P. I	Sep. 30
———	Tunnel, c. i. pipe, etc., Harrisburg, Pa. Adv. Oct. 7.	Oct. 7

SEWERAGE AND SEWAGE DISPOSAL.

Oct. 10.	Norristown, Pa. Adv. Sep. 9 to Sep. 30.	Sep. 9
Oct. 10.	Glencoe, Ill.	Sep. 30
Oct. 10.	Crookston, Minn.	Sep. 30
Oct. 11.	Parkersburg, W. Va.	Sep. 30
Oct. 11.	Rockford, Ill. Adv. Oct. 7.	Oct. 7
Oct. 11.	Montooth, Pa.	Oct. 7
Oct. 12.	3d Ward sewer, Jackson, Mich Adv. Sep. 30.	Sep. 30
Oct. 12.	Intercepting sewers, Jackson, Mich Adv. Sep. 30.	Sep. 30
Oct. 12.	Williamsport, Pa. Adv. Oct. 7.	Oct. 7
Oct. 12.	Newark, N. J.	Oct. 7
Oct. 12.	Green Bay, Wis.	Oct. 7
Oct. 12.	Youngstown, O.	Oct. 7
Oct. 12.	Reading, Pa.	Oct. 7
Oct. 12.	Portchester, N. Y.	Oct. 7
Oct. 14.	Chicago, Ill.	Sep. 30
Oct. 14.	Waynesville, N. C.	Oct. 7
Oct. 15.	Elyria, O.	Sep. 23
Oct. 16.	Cape Girardeau, Mo. Adv. Sep. 16 to Sep. 23.	Sep. 16
Oct. 16.	Cape May, N. J Adv. Sep. 30 to Oct. 7.	Sep. 30
Oct. 16.	Moorhead, Minn.	Oct. 7
Oct. 17.	New York, N. Y	Oct. 7
Oct. 20.	Princeton, Ind.	Sep. 30
Oct. 20.	Lake City, Fla.	Sep. 30
Oct. 21.	Ft. Miley, Cal.	Oct. 7
Oct. 23.	Wauseon, O.	Oct. 7
Oct. 23.	Belding, Mich. Adv. Oct. 7.	Oct. 7
Oct. 24.	Cleveland Heights, O.	Sep. 30
Oct. 26.	Portsmouth, O. Adv. Sept. 30 to Oct. 7.	Sep. 30
Oct. 27.	Keshena, Wis.	Sep. 30
Nov. 2.	Columbus, O. Adv. Oct. 7.	Oct. 7
Nov. 6.	North Yakima, Wash.	Oct. 7
Nov. —.	Rockport, Ind.	Oct. 7
Jan. 12.	Manila, P. I.	Sep. 30
———	Kirkwood, Mo. Adv. Sep. 30.	Sep. 30

BRIDGES.

Oct. 10.	Columbus, O.	Sep. 16
Oct. 11.	Stillwater, Okla. Ter.	Sep. 23
Oct. 11.	Rome, Ga.	Oct. 7
Oct. 14.	Ashland, O.	Sep. 30
Oct. 16.	San Jose, Cal.	Oct. 7
Oct. 19.	Spokane, Wash.	Oct. 7
Oct. 19.	Newport Ind.	Oct. 7
Oct. 21.	Miamisburg, O.	Oct. 7
Oct. 24.	Marion, O.	Oct. 7
Oct. 30.	Camden, N. J.	Sep. 23
Oct. 30.	Refton, Pa.	Oct. 7
Nov. 1.	Portage, Wis.	Sep. 30
Jan. 1.	Pensacola, Fla.	Sep. 30
———	Minnesota City, Minn.	Sep. 9

PAVING AND ROADMAKING.

Oct. 10.	Cincinnati, O.	Sep. 23
Oct. 10.	Altoona, Pa.	Oct. 7
Oct. 10.	Erie, Pa.	Oct. 7
Oct. 11.	Brooklyn, N. Y.	Sep. 30
Oct. 11.	Hollidaysburg, Pa.	Sep. 30
Oct. 11.	Cumberland, Md.	Oct. 7
Oct. 12.	Springfield, O.	Oct. 7
Oct. 12.	Bellaire, O.	Oct. 7
Oct. 12.	Dayton, O.	Oct. 7
Oct. 13.	Concord, N. H.	Oct. 7
Oct. 14.	Washington, D. C. Adv. Sep. 23 to Sep. 30.	Sep. 23
Oct. 14.	Norwood, O.	Sep. 30
Oct. 14.	Zanesville, O.	Oct. 7
Oct. 16.	Ft. Hancock, N. J.	Sep. 30
Oct. 16.	Ft. Oglethorpe, Ga. Adv. Sept. 30 to Oct. 7.	Sep. 30
Oct. 17.	Rensselaer, N. Y.	Oct. 7
Oct. 17.	New York, N. Y.	Oct. 7
Oct. 17.	Ashland, Ore.	Oct. 7
Oct. 18.	Moundsville, W. Va.	Sep. 23
Oct. 18.	Cincinnati, O.	Sep. 30
Oct. 18.	Doylestown, Pa.	Sep. 30
Oct. 18.	Franklin, Pa.	Sep. 30
Oct. 18.	Westchester, Pa.	Oct. 7
Oct. 18.	Nashville, Tenn.	Oct. 7
Oct. 18.	Harrisburg, Pa.	Oct. 7
Oct. 20.	Green Bay, Wis.	Oct. 7
Oct. 23.	Cincinnati, O.	Sep. 30
Oct. 23.	Sherman, Tex. Adv. Oct. 7.	Oct. 7
Oct. 23.	Beloit, Wis.	Oct. 7
Oct. 24.	Columbus, O.	Sep. 30
Oct. 24.	Cincinnati, O.	Oct. 7
Nov. 1.	Steelton, Pa. Adv. Sept. 2 to Oct. 7.	Sep. 16

POWER, GAS AND ELECTRICITY.

Oct. 10.	Supplies, Washington, D. C.	Sep. 23
Oct. 10.	Washington, D. C.	Sep. 30
Oct. 10.	Fayetteville, N. C.	Oct. 7
Oct. 11.	Lockport, Ill.	Aug. 19
Oct. 11.	Baltimore, Md.	Oct. 7
Oct. 12.	Ludlow, Ky.	Oct. 7
Oct. 12.	Kansas City, Mo.	Oct. 7
Oct. 12.	New York, N. Y.	Oct. 7
Oct. 15.	Reading, O.	Aug. 26
Oct. 16.	Ft. Monroe, Va.	Sep. 23
Oct. 17.	Washington, D. C.	Sep. 30
Oct. 17.	Washington, D. C.	Oct. 7
Oct. 23.	Chicago, Ill.	Sep. 30
Oct. 24.	Columbus, O.	Sep. 30
Oct. 31.	Washington, D. C	Sep. 30
Nov. 1.	Chicago, Ill.	Sep. 9
Nov. 1.	Roosevelt, Ariz.	Sep. 16
Nov. 2.	Roosevelt, Ariz.	Sep. 23
Nov. 8.	Washington, D. C. Adv. Sept. 30 to Oct. 7.	Sep. 30
Nov. 18.	Tacoma, Wash.	Sep. 30
Dec. 2.	**San Juan, Porto Rico**	**Aug. 19**

BUILDINGS.

Oct. 10.	Court house, Enid, Okla. Ter	Sep. 23
Oct. 10.	School, Wallingford, Conn.	Sep. 30
Oct. 11.	Brick for pub. bldg., Wash., D. C.	Sep. 30
Oct. 12.	P. O. extension, Fargo, N. D	Sep. 9
Oct. 12.	School, Holland, Mich.	Sep. 23
Oct. 12.	School, Jersey City, N. J	Oct. 7
Oct. 13.	Post bldgs., Ft. H. G. Wright, N. Y.	Sep. 30
Oct. 13.	Post bldg., material, Ft. Meade, S. D.	Sep. 30
Oct. 14.	Drill hall, Toronto, Ont	Sep. 30
Oct. 14.	Pub. bldg., Springfield, O.	Sep. 30
Oct. 14.	Post bldg., Ft. Brady, Mich	Sep. 30
Oct. 15.	Court house, Jersey City, N. J	Sep. 23
Oct. 16.	Court house, Gretna, La.	Sep. 2
Oct. 16.	School, San Francisco, Cal.	Sep. 16
Oct. 16.	Pub. Bldgs., Sheboygan, Wis	Sep. 23
Oct. 16.	School, Stillwater, Okla. Ter	Sep. 30
Oct. 16.	School, Louisville, Ky.	Oct. 7
Oct. 16.	Library, Wausau, Wis.	Oct. 7
Oct. 16.	Schools, New York, N. Y	Oct. 7
Oct. 18.	Post Bldgs., Vancouver Barracks, Wash. Adv. Sep. 16 to Sep. 30.	Sept. 10
Oct. 18.	Post bldg., Ft. Sam Houston, Tex Adv. Sep. 23 to Oct. 7.	Sep. 23
Oct. 18.	Hospital, Ft. Wood, N. Y. Harbor, N. Y.	Oct. 7
Oct. 18.	Pub. bldgs., Harrisburg, Pa.	Oct. 7
Oct. 19.	School, Tomah, Wis.	Sep. 30
Oct. 19.	Post bldg., Ft. McIntosh, Tex	Sep. 30
Oct. 20.	School, San Pedro, Cal.	Sep. 23
Oct. 21.	Co. bldg., Staunton, Va	Sep. 30
Oct. 25.	Pub. Bldgs., Washington, D. C	Sep. 16
Oct. 26.	Roof work on school, Washington Barracks, D. C. Adv. Sep. 30 to Oct. 7.	Sep. 30
Oct. 26.	School, Youngstown, O.	Oct. 7
Oct. 26.	School, Platteville, Wis.	Oct. 7
Oct. 27.	School, Keshena, Wis.	Sep. 30
Oct. 27.	Post bldgs., Ft. Leavenworth, Kan	Oct. 7
Oct. 30.	School, Lancaster, O.	Oct. 7
Oct. 30.	Hospital bldgs., Overbrook, N. J	Oct. 7
Oct. —	City hall, Fargo, N. D	Sep. 30
Nov. 1.	Pub. bldg. plans, Salem, Mass	Sep. 16
Nov. 14.	P. O. bldg., Colorado Spgs., Colo Adv. Sep. 23 to Sep. 30.	Sep. 23
Nov. 15.	School, Cleveland, O.	Sep. 16
Dec. 1.	Dwelling, Wilmington, N. C	Sep. 16
Dec. 12.	Remodel. capitol, Bismarck, N. D	Sep. 30
Jan. 1.	Hotel, Davenport, Ia.	Sep. 30
Jan. 10.	Library plans, Toronto, Ont.	Sep. 23

MISCELLANEOUS.

Oct. 10.	Supplies, Washington, D. C	Sep. 9
Oct. 10.	Cement, Guantanamo, Cuba. Adv. Sep. 16 to Oct. 7.	Sep. 16
Oct. 10.	Garb disp., Bridgeport, Conn	Sep. 16
Oct. 10.	Supplies, Washington, D. C	Sep. 23
Oct. 10.	Improv. Lock, Dresden, O	Sep. 23
Oct. 10.	Pier, Swinburne Island, N. Y. H., N. Y. Adv. Sep. 30.	Sep. 30
Oct. 10.	Supplies, Washington, D. C	Sep. 30
Oct. 10.	Dike, Columbia, La.	Sep. 30
Oct. 10.	Ditch, Marshalltown, Ia.	Sep. 30
Oct. 11.	Pier, Muskegon, Mich. Adv. Sep. 16 to Oct. 7.	Sep. 16
Oct. 11.	Engr. supplies, Panama	Sep. 30
Oct. 11.	Canal work, Ottawa, Ont.	Sep. 30
Oct. 11.	Fire alarm system, New York, N. Y.	Oct. 7
Oct. 12.	Dredging, Seattle, Wash	Sep. 23
Oct. 12.	Dredging, New York, N. Y Adv. Sept. 30 to Oct. 7.	Sep. 30
Oct. 13.	Drains, Pocahontas, Ia Adv. Sep. 23 to Sep. 30.	Sep. 23
Oct. 13.	Spreaders, Panama	Oct. 7
Oct. 14.	Grading, New Orleans, La.	Sep. 30
Oct. 14.	Dredging, Charleston, S. C Adv. Sep. 30.	Sep. 30
Oct. 14.	Breakwater, Indian Head, P. E. I.	Sep. 30
Oct. 16.	Dikes, etc., New York, N. Y Adv. Sept. 30 to Oct. 7.	Sep. 30
Oct. 16.	Dredging, New York, N. Y Adv. Sep. 30 to Oct. 7.	Sep. 30
Oct. 16.	Supplies, Panama	Oct. 7
Oct. 16.	Ditch, Olivia, Minn.	Oct. 7
Oct. 17.	Locomotive crane, Boston, Mass	Sep. 23
Oct. 17.	Supplies, San Juan, P. R	Sep. 23
Oct. 17.	Cement, Guantanamo, Cuba	Sep. 30
Oct. 17.	Dredging, New York, N. Y Adv. Oct. 7.	Oct. 7
Oct. 17.	Supplies, Washington, D. C	Oct. 7
Oct. 19.	Ditch, Moorhead, Minn.	Oct. 7
Oct. 19.	Elevator, Lincoln, Neb.	Sep. 30
Oct. 21.	Dredging, Washington, D. C. Adv. Sep. 23 to Oct. 7.	Sep. 23
Oct. 23.	Dredging Machine, Philadelphia, Pa Adv. Sep. 16 to Oct. 7.	Sep. 16
Oct. 23.	Vacuum cleaning system, P. O. Bldg., Lincoln, Neb. Adv. Oct. 7.	Oct. 7
Oct. 24.	Supplies, Pensacola, Fla.	Oct. 7
Oct. 25.	Dock, Chicago, Ill.	Sep. 2
Oct. 25.	Wharf, Washington, D. C	Sep. 16
Oct. 27.	Rip rap, etc., New York, N. Y Adv. Sep. 30 to Oct. 7.	Sep. 30
Oct. 28.	Remov. rock, etc., Portsmouth, N. H.,	Oct. 7
Oct. 30.	Dredging, Washington, D. C Adv. Oct. 7.	Oct. 7
Oct. 31.	Dredging, San Francisco, Cal	Sep. 30
Nov. 1.	Garbage franchise, New Orleans, La.	Sep. 16
Nov. 1.	Jetty, Washington, D. C Adv. Oct. 7.	Oct. 7
Nov. 3.	Ammunition hoists, Wash., D. C	Oct. 7
Nov. 6.	Garb. disp., New York, N. Y Adv. Sep. 9 to Oct. 7.	Sep. 2
Nov. 6.	El. Ry. franchise, Woodland, Cal	Sep. 30
Nov. 9.	**Wharf, etc., Havana, Cuba**	**Jul. 29**
Dec. 15.	R. R., Manila, P. I	Sep. 16
Jan. 1.	**Statue plans, Indianapolis, Ind**	**Jul. 22**
Apr. 2,	**'06. Harbor Work, Valparaiso, Chili,** Adv. Apr. 29 to Sep. 9.	**Apr. 29**
———	Grading, Baltimore, Md. Adv. Sep. 30 to Oct. 7.	Sep. 30

**Items marked thus give the names of parties awarded contracts.*